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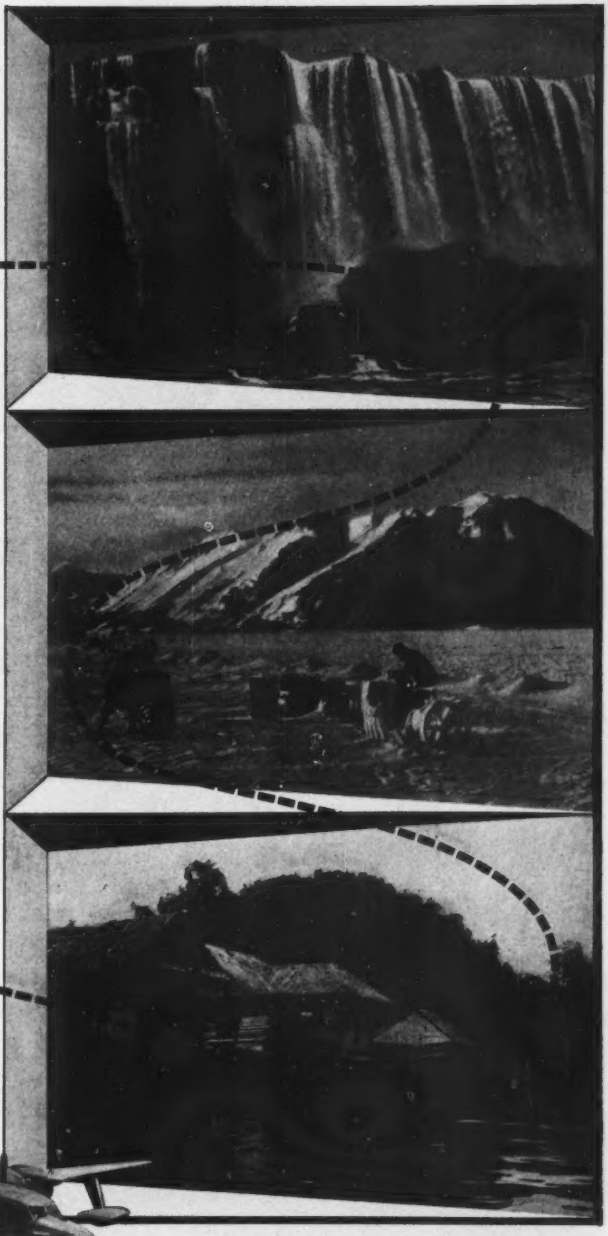

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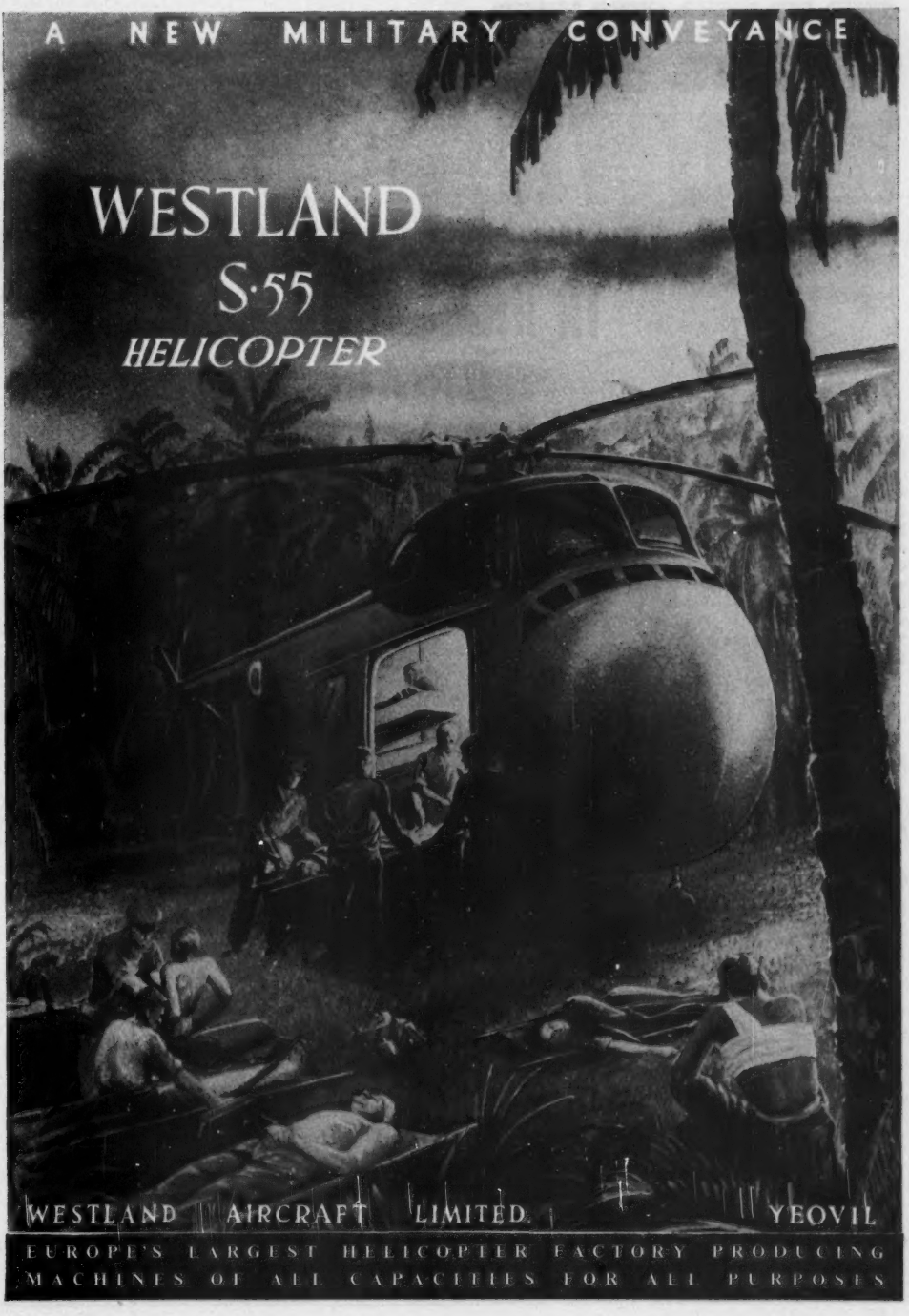
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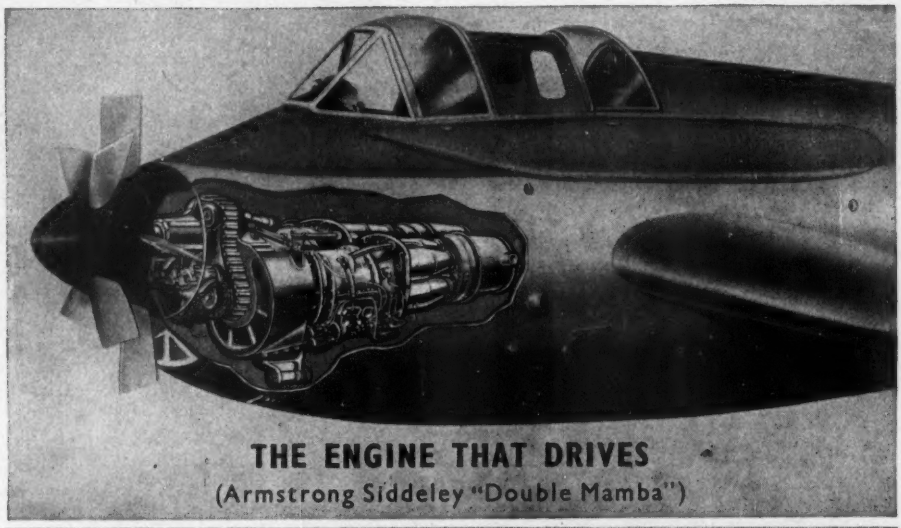

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Protection at High Altitudes

WHERE resources are limited, it is not always possible to progress all branches of aviation research and development as quickly as would be desirable, though in peace-time such a situation can usually be met by allocating priorities. It would be fatal, however, to lose sight of the fact that, with full defence preparedness as the aim of the Services, everything must sooner or later be brought to a state of complete readiness.

A good start has been made towards equipping the R.A.F., but it is no more than that. The absence of new forms of military radar is one important example of a most disturbing deficiency in equipment. The recent Atlantic crossing by the Canberra, which at times flew at over 40,000ft, indirectly drew attention to another—the still limited provision against sudden decompression at very high altitudes.

In a recent issue of *Flight* (dated January 25th) there was a description of the work of a small but active and efficient organization, the Royal Air Force Institute of Aviation Medicine located with the R.A.F. at Farnborough. Here the design of pressure suits and of oxygen systems for use with them is receiving attention. The Canberra, believed to be capable of flying at over 50,000ft, is a type of aircraft which will soon be in squadron use, and already fighters are in production which are capable of a similar altitude performance. Pressure suits for their pilots and crews are not, it is believed, ready even in a prototype form, so several months must elapse before any examples can be tested, approved, and then produced in sufficient numbers to satisfy the immediate needs.

Much has always been expected of R.A.F. (and, of course, Reserve) aircrews, yet they have never disappointed those who have to set them their tasks. No discredit is therefore implied in mentioning the fact that there is a reluctance on the part of many pilots to fly very high, even though experience in handling their aircraft in the region of 40,000ft is essential.

The time has come when full pressure-suits (as opposed to the valuable half-measure—oxygen-fed pressure-waistcoats with the aid of which lung and outside pressures are, in part, balanced) should be available to R.A.F. jet squadrons. With the double insurance that these and a pressure cabin would give, there would be little danger in stratospheric flying as a routine exercise. This must, in fact, be regarded as an essential part of the regular training and practice of aircrews, whether in preparation for defensive interception or high-altitude attack.

As operational speeds and altitudes increase so must the various safety devices be developed in order to keep pace. No modern fighter should be without its ejector seat—a device pioneered in this country—but even these in their present form are scarcely adequate. To abandon an aircraft at high speed is still very hazardous, and the occasions upon which ejector seats have been used—either in emergency or in practice—can still be numbered in dozens.

Capsules—A Future Requirement

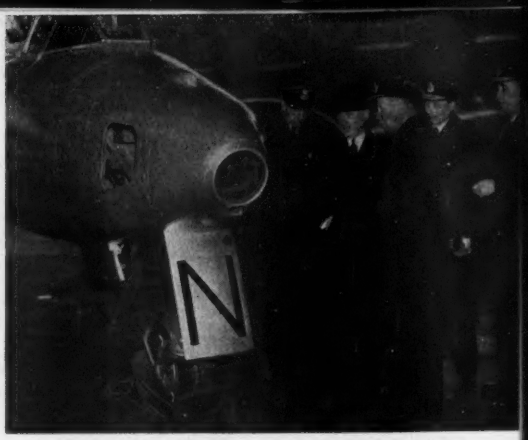
Complete pressurized cockpit-units—jettisonable as a whole—require further investigation, for the human body cannot be exposed to a slipstream of over about 500 m.p.h. with any degree of safety, nor can life be sustained without a pressure suit and a pressure-breathing system at altitudes above 45,000ft, or even 40,000ft for many individuals. For an emergency descent, oxygen must be provided down to 25,000ft or lower if full physical faculties are to be retained.

In short, as much effort and experiment should be devoted to high-altitude emergency survival as has been given to escape apparatus for submarine crews trapped below the sea. The two cases, extreme opposites in one sense, are in fact related in another, survival without special pressure and breathing equipment once the craft has been abandoned being impossible.

OPEN DAY AT BENSON

Exhibition of latest photographic-reconnaissance methods; Meteor P.R.10s in squadron service

(Illustrated by "Flight" Photographs)

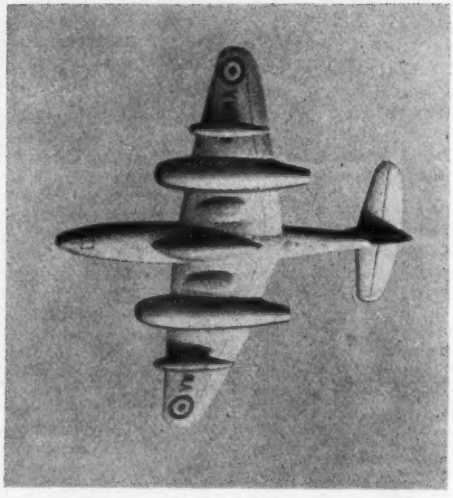


W/C. Thompson, O.C. Photographic Wing at Benson, introduces the Meteor 10 to (left to right): Mr. Arthur Henderson, Sir Hugh Lloyd, Sir Ralph Cochrane and Sir Arthur Sanders.

THE application of aerial photography to intelligence and survey was the theme of an unusually comprehensive exhibition held at Benson R.A.F. Station in Oxfordshire on February 28th. For its 450 guests, Bomber Command, which administers this centre of R.A.F. photographic activity, provided a static display of "S.B.A.C." proportions and a flying programme on a more modest scale, though fully up-to-date. Those present represented Industry and the services of the Commonwealth, America and Western Union; and the air attachés of 15 nations also attended (the Yugoslav emissaries had, it was said, been "cleared by Security"; no true satellite of Moscow was invited). Mr. Arthur Henderson, the Air Minister, was there, together with Air Chief Marshal Sir Ralph Cochrane, Vice-Chief of the Air Staff, Air Marshal Sir Arthur Sanders, Deputy C.A.S.; and Air Marshal Sir Hugh Lloyd, A.O.C.-in-C., Bomber Command.

The resident units at Benson, which was formerly known as the Central Photographic Establishment, are one survey squadron and two short-range day reconnaissance squadrons. Ansons equip the survey unit, one P.R. Squadron still uses Mosquito 34s, and the third squadron has now converted from Spitfire 19s to Meteor 10s. For many, the presence, in squadron service, of the new jet reconnaissance aircraft was one of the most interesting and reassuring aspects of the exhibition.

About a dozen Meteor 10s were to be seen. One, in the static exhibition, bore the badge of No. 541 Squadron (motto: Alone above All) and its camera installations were laid bare. For oblique photography, an F.24 camera is mounted in the nose; mountings and windows are arranged

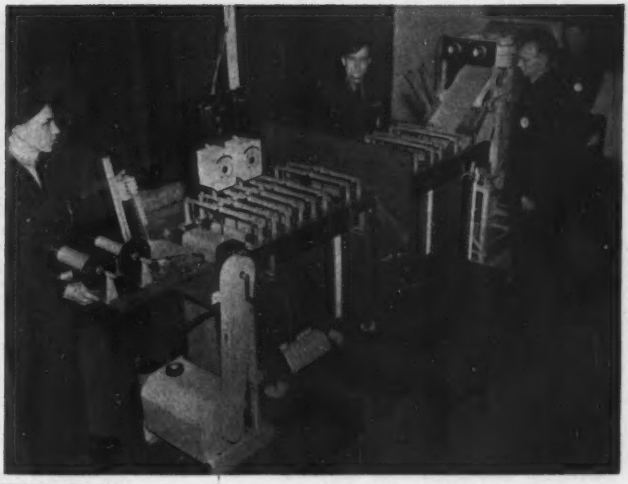


In flight, the Meteor 10 displays its extended wing-tips and external fuel-tanks; oblique and vertical cameras are carried in nose and mid-fuselage.

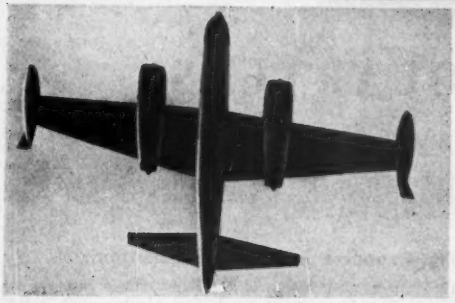
Re-equipment of P.R. units of the R.A.F. is illustrated by this squadron line-up of Gloster Meteor 10s at Benson.

The badge of No. 541 (P.R.) Squadron, displayed on a Meteor in the static exhibition.

(Below) The Tornado shows its paces: plan view of the North American RB-45c.



Demonstration of mechanical film processing; this machine can develop and dry a 500-exposure film in 1 hr 40 min.



Second of the U.S.A.F. types demonstrated at Benson, an RB-50 flies past.

to allow it to "fire" forward, port or starboard. For split cover, two F.52 cameras are mounted vertically in the mid-fuselage. Camera controls are mounted in place of the gun-sight. The aircraft itself combines the features of various marks of Meteor: its fuselage is of the extended Mk. 8 type, with bubble canopy and Martin-Baker ejector seat, but the tail unit has the curved profile of earlier marks. The wings of the Meteor 10 are extended, as on the earliest Meteors, for better handling qualities at altitude; for longer range, the internal tankage is supplemented by 380 gallons of fuel in drop-tanks—180 beneath the fuselage, 200 in the wing-tanks.

Also on view in the static exhibition, held in a large hangar, were a Spitfire 19 and Mosquito 34. The display sections illustrated every side of R.A.F. aerial photography. Cameras were shown in two sections—ancient and modern. Eight old cameras showed various stages in development from the 18-plate P.7 type of the first world war to the F.8 camera-gun, which served from 1930-43. Typical cameras in the larger modern section were the Williamson F.24, as in service with the U.S.A.F. and Western Union air forces in addition to the R.A.F., and the larger F.52 with longer focal length.

Methods of manufacturing and testing lenses were shown in the optics section; one particularly interesting development seen here was the method of weight-saving which may well lighten by 100 lb a typical camera installation for a P.R. aircraft. Two standard 36in f6.3 Ross telephoto lenses were displayed: though almost identical in appearance and size, one weighed 18½ lb but the other only 8¼ lb. The difference was achieved mainly by the use of Elektron light alloy, instead of brass and steel, in fabrication of the lighter lens-holder.

Various methods of processing were exhibited—in a field section and mobile darkrooms and by the more elaborate automatic machines, which can develop and dry a 500-exposure length of film in 1 hr 40 min, and produce trimmed and dried prints at a rate of 600 per hour.

Actual utilization of prints was demonstrated in several ways. The Royal Engineers provided a field section working on the production of maps from photographs, and the method of constructing briefing models for aircrews, paratroops or invasion forces was also revealed. The models, made of plaster, paper pulp and size, are first assembled as contour layers, which are filled-in and photo-skinned before the final colouring and addition of detail. An intriguing selection of wartime photographs illustrated the art of the interpreter, who, with magnifying glass, slide rule, measuring instruments

OPEN DAY AT BENSON . . .

and stereoscope, can detect the most elaborate forms of camouflage. Tricks developed by the Germans to deceive the interpreter included such devices as "damaflage"—painting air-raid effects on factories and other targets—and decorating a cruiser to make it resemble an off-shore naval barracks.

On the civil side, the Ministry of Supply showed instruments for ordnance and colonial surveys, including stereoscopic mapping equipment with 14 projectors which throw on to a screen the image of a landscape in relief; from this, operators are able to measure heights of hills and mountains. Other M. of S. items were the integrating light meter which automatically adjusts exposure-times of prints to ensure uniform contrast; Densitometer, allowing for variations in daylight during a long flight; and the Photonymograph, which reproduces place-names and other lettering for maps by photographic means. Another section was devoted to illustrating equipment and methods used by No. 82 Squadron (Lancasters) in its colonial-development survey of East and West Africa—work which began some four years ago and is still in progress.

The Central Photographic Print Library, which is located at Medmenham, houses a collection of some 25,000,000 photographs, most of which are available to the public. Part of the Benson exhibition demonstrated the methods used to ecord and index this enormous store of prints—methods which enable photographs of any given geographical site to be produced within a few minutes. Often a choice of scale, date, time, weather and angle of photography can be offered. The C.P.P.L. collection represents about 70 per cent. of all the photographs taken by the R.A.F. during and since the war; for the past year, new prints have been arriving at the rate of 110,000 per month.

The exhibition concluded with a lively flying display by three resident and three visiting aircraft. The last generation of P.R. aircraft was represented by the Spitfire 19 and Mosquito 34, in familiar blue finish. The all-silver Meteor 10, with full external tankage, provided a contrast in performance and appearance; its level runs, though not at full throttle, were obviously at a greater speed than the 325 m.p.h. limit inaccurately quoted by the commentator. No figures may be given for the Meteor 10, but its cruising speed at high altitude, even with three external tanks, is certainly in the region of 500 m.p.h. Two more interesting P.R. aircraft were demonstrated by the U.S.A.F.: a North American RB-45C Tornado and a fully armed Boeing RB-50. Finally, the English Electric Company contributed a new production Canberra B.2, which gave the astonishing performance now expected from this twin-Avon bomber. This Canberra carried a camera in the fuselage aft of the bomb-bay; this is, however, a standard fitting for the bomber version. Development of a P.R. Canberra has not yet been announced, but is patently a logical development—as foreshadowed by the aircraft's visit to Benson.

FROM ALL QUARTERS

Anglo-Belgian Agreement

UNDER the terms of a reciprocal agreement initialled in Brussels on March 2nd, British civil air services are to be assured of permanent rights to operate to Belgium and the Belgian Congo. The agreement supersedes the temporary arrangement under which services had been flown between the two countries since the war. Likewise, the Belgian State airline, Sabena, is now officially authorized to operate on routes serving the United Kingdom and Colonial territories in Africa.

It is understood that the agreement will take effect from the day on which it is finally signed, probably some time next week.

Britannia Trophy For P. A. Wills

THE Britannia Trophy for 1950, announces the Royal Aero Club, has been awarded to Mr. Philip Wills, C.B.E., in recognition of his achievement in winning the British National Gliding Championships for the fourth time. He won in 1950, and had previously been successful in 1937, 1947 and 1949.

This is only the second time that the Trophy has been awarded for a gliding achievement. In 1922 it went to Mr. F. P. Raynham for a soaring flight of 1 hr 53 min 2 sec in a Handasyde glider at Firle Beacon, Sussex, on October 17th, 1922.

It was last awarded in 1948—to G/C. John Cunningham, D.S.O., D.F.C., for gaining the aeroplane height record of 59,446ft for Great Britain.

The Britannia Trophy was presented to the R.Ae.C. in 1913 by Mr. Horatio Barber, holder of Aviator's Certificate No. 30, and designer and constructor of the Valkyrie tail-first monoplane and Viking biplane of 1910. It is awarded to the British pilot who, in the opinion of the Club committee, has accomplished the most meritorious performance during the year.

Mr. P. A. Wills, C.B.E.

Mr. Wills, who is 43 and lives near Maidenhead, is chairman of the British Gliding Association. During the war he was Director of Operations and second-in-command of Air Transport Auxiliary. He gained his "A" and "B" Gliding Certificates in 1933, and holds the International Gold Badge for gliding.

He has been awarded the Manio Cup, the de Havilland Cup and the Wakefield Trophy on numerous occasions for his performances, and has established many gliding records for speed, height, distance and goal-flights.

The Canberra And U.S. Production

IN Washington, on March 1st, Mr. Finletter (U.S. Secretary for Air) stated in regard to the English Electric Canberra that "the evaluation so far is that it is the best available light bomber" and that it has "pretty well been decided to manufacture it in America." It will probably be built, he said, at the Glenn Martin plant in Baltimore, Maryland. No contract has yet been signed.

Announcement was made by Mr. Finletter of a contract "from the drawing-board" for the Boeing B-52 jet bomber, the first deliveries of which were expected late this year. It was pointed out that there was some risk in starting production without flight tests, but the B-52 was described as "only a bigger version of the B-47". The B-52, said Mr. Finletter, would be capable of flying at more than 600 m.p.h. and carrying as big a bomb load as the Convair B-36. He added that a contract had been placed for a swept-wing development of the B-36.

P. G. Robarts: An Appreciation

A WARM appreciation of the personal qualities of S/L. P. G. Robarts, whose death in a test-flying accident we recorded on February 15th, reaches us from one of his colleagues.

"He had a great interest in, and a very good practical knowledge of, all things mechanical. This was one of the things which made him such a valuable asset to a test-flying establishment; there wasn't much that Peter didn't know about what went on 'under the bonnet,' and he was a thoughtful and thoroughly reliable pilot. He had a whimsical sense of humour which, combined with his robust refusal ever to use in conversation any technical terms which he regarded as pompous (and to him this meant most technical terms), often led the unwary and undiscerning into the trap of under-estimating his knowledge of a subject; his friends got much quiet pleasure out of listening to arguments in such circumstances, during which Peter would quietly, but inexorably and in pleasant but highly unorthodox terms, cause his opponent to revise his original estimate.

"Perhaps his greatest charm lay in the fact that one could meet him and get to know him quite well without ever suspecting that he earned his living as a test pilot of jet fighters. He had so many other interests: he was a keen shot and a very good horseman—

he kept his own horse near Chilbolton and was out early most mornings before flying. He was very fond of music and ballet, interested in most forms of art and knew a great deal about country things. He knew a lot about electricity and wireless and enjoyed fast cars, which he was inclined to drive round corners with a somewhat boisterous disregard for centrifugal force. He had travelled to most countries in the world and he would describe them and their inhabitants in his own very individual way.

"It is not always easy to say why people become test pilots. Peter Robarts had great opportunities in other directions and he certainly had the latent ability to have made a success of them had he so desired. But he was one of those rare and happy beings who know exactly what they want to do—and then do it." J.K.Q.

A.F.R.Ae.S. Examination Results

THE Royal Aeronautical Society, has published a list of candidates successful in the Associate Fellowship examination (new syllabus), held last December. Subjects chosen included pure and applied mathematics, properties of matter, strength of aircraft materials, theory of structures, aerodynamics and theory of prime movers and fuels. The following passed :—

H. A. Buchholdt, D. W. Cocking, R. S. Dabbs, D. A. Drane, G. H. Fenton, V. N. Ferriman, D. R. Henbest, R. L. Holmes, B. M. Laven, E. Mowforth, C. L. Munro, W. A. Page, G. S. Pool, C. R. Raynham, B. Shergill, I. H. Smart, K. Thein, F. I. V. Walker.

Overseas candidates.—A. F. El-Kerdani (Egypt), Krishna Iyer (India).

A Gliding Birthday

LAST Saturday, March 3rd, the Imperial College Gliding Club celebrated the 21st anniversary of its formation with a reception and dinner, held at the College Union, South Kensington, London. Sir Roderic Hill, Rector of the College and president of the gliding club, received the guests, among whom were a number of aviation pioneers.

During the evening Sir David Brunt, the professor of meteorology at the college, presented his own trophy to Mr. Lionel Alexander, who with a climb of 6,800ft had won the inter-university altitude competition. This was the third occasion on which Cambridge had won the trophy.

Organized gliding at British universities is at the moment confined to Cambridge, the Imperial College at London and to the recently formed Bristol University Club; there is no active gliding club at Oxford.

Flush-fitting Fuel Fillers

IN common with several other types of Service and civil aircraft, the English Electric Canberra is fitted with flush-fitting fuel fillers, designed and manufactured by the Heston Aircraft Co., Ltd., of Heston Airport.

The first type produced was adopted by the S.B.A.C. under standard No. A.S.2590; this is suitable for a maximum working pressure of 15 lb/sq in, and for use with either "hard" or bag-type tanks. It is so arranged that water and fuel cannot find their way to the interior of the aircraft structure, both rain-water and spilt fuel being piped overboard, if so desired, by way of a connection provided for the purpose.

The company has lately developed an improved type (J58M) which has recently been adopted by the S.B.A.C. in two standard forms—A.S.3365, with a $\frac{3}{4}$-in diameter vent connection, and A.S.3366, without vent connection. These two types are intended eventually to supersede the original pattern described above. The new fillers can be fitted between stringers only 4in apart, but the general principle remains unaltered. They weigh 1.2 lb and 1.14 lb respectively, and have a curvature of 0.04 in per 4 in on the top surface. The synthetic-rubber sealing ring is common to all these fillers, and the lid can be opened and closed, without tools, while arctic-type gloves are being worn. Icing trials and a severe vibration test have been successfully completed.

Standard equipment on the English Electric Canberra is the Heston Aircraft flush-fitting fuel-filler, as illustrated and described above.

Princesses for the R.A.F.

REPORTS earlier this week confirmed recent forecasts in *Flight* that the three Saunders-Roe Princess flying-boats under construction for B.O.A.C. would, in fact, be used for military purposes. No official statement has been made as to the new rôle of the Princesses, but they will, presumably, be handed over to Transport Command for carrying troops and bulky, high-priority freight.

Still More Luxury

THE first flight on B.O.A.C.'s new Monarch service by Stratocruiser between London and New York was made on Friday, March 2nd. Fifty-two passengers were carried, and elapsed time—including an hour's stop at Gander—was about 17 hr, 75 m.p.h. headwinds being encountered along most of the route.

Introduced with the intention of attracting a major share of the dollar sales on this competitive route during the Festival of Britain year, the Monarch service probably provides the most luxurious amenities ever offered to passengers. Complimentary cocktails, a seven-course dinner and free beauty packs for women are all included in the £147 7s. fare for a 15-day excursion ticket, which is effective until March 31st.

The inauguration of these flights has brought the international struggle for passenger-favour among the Atlantic airlines to a new degree of intensity and, though in themselves the luxuries do not represent any very appreciable proportion of the fare charged, it is difficult to see where competition in comforts is likely to end. It is believed that the subject will be brought up for discussion by I.A.T.A. at an early opportunity.

The Sikorsky S.65

PRELIMINARY details have now appeared of the Sikorsky S.65 twin-engined transport helicopter, a successor to the S.55, which is now in production. Quoted by American sources as being "now under development," the S.65 will be powered by two 800 h.p. radials and will have a gross weight of about 16,000 lb. Fuselage length will be 55ft, and width, 9ft 6in. The rotors will have a span of 73ft and seating capacity is believed to be 24.

For comparison, the Bristol 173, which is designed for a 13-seat capacity, is of 10,600 lb normal a.u.w. and is powered by two 550 h.p. Alvis Leonides radials.

Two Sikorsky S.55s, incidentally, are scheduled for delivery to Los Angeles Airways early next year.

Stainless-steel Hose

CLAIMED to be "one of the most important developments in flexible-pipe-assembly design since high-performance synthetic rubber hose was introduced into this country before the war," a new type of hose has been announced by Avica Equipment, Ltd., 50 Pall Mall, London, S.W.1.

It consists of a highly flexible stainless-steel convoluted pipe reinforced and protected with various arrangements of outer braiding in accordance with internal-pressure requirements. The use of stainless steel renders the piping adaptable to wide extremes of temperature and not susceptible to damage by various normally harmful fluids and gases. Complete assemblies are available, with straight integral-angle or flange-type couplings as required.

A preliminary data-sheet issued by Avica shows a range of 17 internal diameters from 3/16in to 4in, maximum bend-radii from $1\frac{3}{4}$in to $16\frac{1}{2}$in and working pressures running from 700 lb/sq in for the smallest diameters to 65 lb/sq in for the largest; corresponding tested pressures are 2,100 lb/sq in and 130 lb/sq in respectively. Weights run from $\frac{1}{2}$ oz to $27\frac{1}{2}$ oz per foot.

For Yachtsmen

THERE is a kindred spirit among aviators and yachtsmen, an overlap in their interests, and both react in a similar manner to the arrival of spring weather. The announcement that our associate journal *Yachting World* has produced its annual fitting-out number in March, price 2s. 6d. (now available from newsagents or direct from the publishers) will, therefore, be of interest to many *Flight* readers.

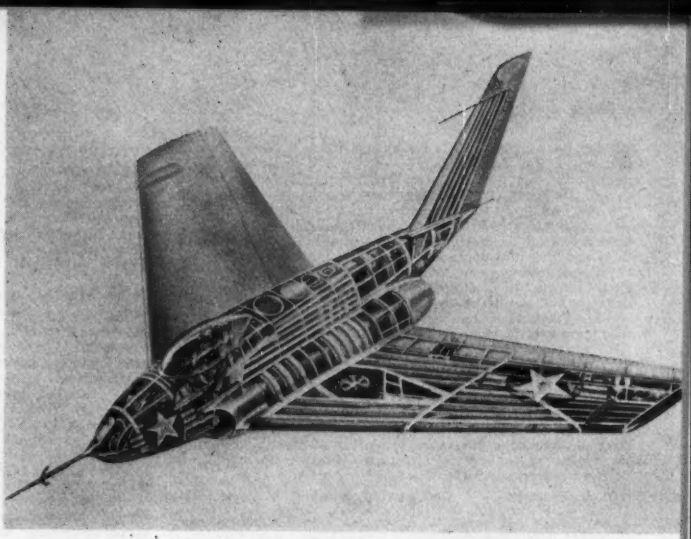
January Export Figures

EXPORTS by the British aircraft industry for January last totalled £3,516,441—a very considerable increase in comparison with the January, 1950, figure, which was £2,721,544. The new total includes engines, components and accessories, with the exception of magnetos and tyres. The usual breakdown of the figures into quantities is not yet available.

Imports for January, 1951, amounted to £1,003,429.

During the past three years the export figure has risen, sharply at first, and then more gradually; annual totals have been £26,004,784 in 1948, £34,215,177 in 1949 and £34,275,423 in 1950.

HERE AND THERE



X-4 EXPLODED: First view of the interior arrangements of the Northrop X-4 twin-jet trans-sonic research aircraft. The X-4, which may be regarded as an American counterpart to the D.H. 108 has a top speed of approximately 650 m.p.h.; power units are two Westinghouse J-30 axial turbojets, each giving 1,600 lb thrust without recourse to the afterburners fitted.

Swiss Venoms?

THE Swiss Government last week authorized the purchase of 150 "improved versions" of the Vampire, presumably D.H. Venoms. It is emphasized by de Havillands that the aircraft will be built under licence in Switzerland; deliveries to the R.A.F. will not be affected in any way.

Missile Inspection

FOLLOWING a visit to Australia in connection with guided-missile development, Air Marshal Sir Alec Coryton, Controller (Guided Missiles), and Sir Harry Garner, Chief Scientist, Ministry of Supply, are making a tour of factories and proving-grounds concerned with similar work in the United States.

Heavier Metal

TRACTORS are now being built by the German Heinkel company. According to a recent Cape Town report, the organization will soon begin exporting tractors and other farm machinery to South Africa. If the demand proves satisfactory, a Heinkel assembly works may be set up outside Johannesburg.

R.Ae.S. Garden Party

SOME unusually interesting lighter-than-air craft, about which nothing may be disclosed at the moment, are to appear at the annual garden party of the Royal Aeronautical Society at White Waltham on Sunday, May 6th. Tickets, strictly limited in number, will be available only to the Society's guests and members, who are advised to apply as early as possible. As in the previous two years, the garden party will be given a prewar atmosphere by the presence of historical aircraft, together with helicopters and new light aircraft.

Family Affair

UNITED Air Lines, whose 25th anniversary is marked pictorially on p. 288 of this issue, claim to employ the only air-going father and daughter in civil aviation. The father is Capt. Ralph Johnson, who flies Stratocruisers on the California-Hawaii route; his daughter Geraldine ("pert, pretty") is employed as a stewardess by the same company.

Amazing Mystery

COLONEL ROZANOFF, test pilot for the French Marcel Dassault Company, is now flight-testing the M.D. 452 Mystère, a swept-wing version of the Nene-powered Ouragan fighter. After four flights, according to a French source, Col. Rozanoff declared that the aircraft had "amazing qualities." So far, flights have extended to 40,000ft, the cockpit-pressurization has been tested, and maximum speed attained.

First details are announced of a new Dassault fighter, the Aladin. This single-seater is developed from the Ouragan and Mystère, but carries radar in the nose and has fuselage-side intakes. A two-seat Aladin is being developed for night and all-weather fighting.

"Flight" photograph

DR. A. M. BALLANTYNE, Ph.D., A.F.R.Ae.S., A.M.I.C.E., A.M.I.Struct.E., who, as announced last week, has been appointed to succeed Capt. Laurence Pritchard as secretary of the Royal Aeronautical Society.

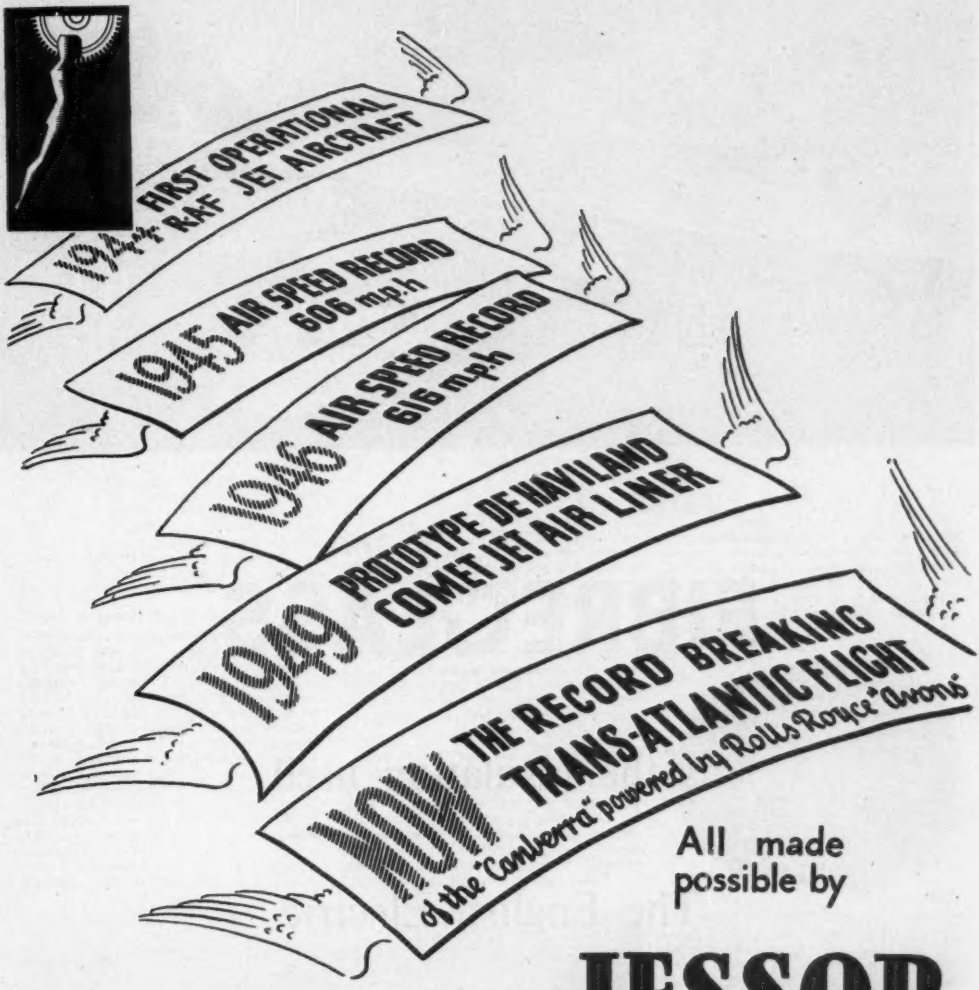
HELICOPTER GATHERING: Cheerful group at the first annual dance of the Bristol Aeroplane Company's helicopter department last Friday: (left to right) Mr. A. E. Russell, Mrs. Hafner, Mr. R. S. Brown, Mr. Raoul Hafner, Mr. N. E. Rowe, Mrs. Rowe, Mr. A. J. Pegg, and Mrs. Brown.

U.S. Bases in France

TWO bases are to be set up in France for the U.S.A.F. They will be situated in the Nimes-Orange area, north-west of Marseilles, and will have runways capable of accommodating heavy bombers and jet fighters. It was recently announced that the U.S.A.F., would also establish five air bases in Morocco.

Handing Back Heligoland

BOMBING of Heligoland by R.A.F. and U.S.A.F. aircraft will stop within a year. This promise was given to the German Federal Government last week by Sir Ivone Kirkpatrick, the British High Commissioner. The British decision to discontinue the use of Heligoland as a bombing range as soon as other targets have been found (and in any case not later than March 1st, 1952), was not, it was stressed, affected by recent Communist action in sending "squatters" to Heligoland. Dr.


1944 FIRST OPERATIONAL R.A.F. JET AIRCRAFT
1945 AIR SPEED RECORD 606 m.p.h
1946 AIR SPEED RECORD 616 m.p.h
1949 PROTOTYPE DE HAVILAND COMET JET AIR LINER
1951 THE RECORD BREAKING TRANS-ATLANTIC FLIGHT of the "Canberra" powered by Rolls Royce "Avons"

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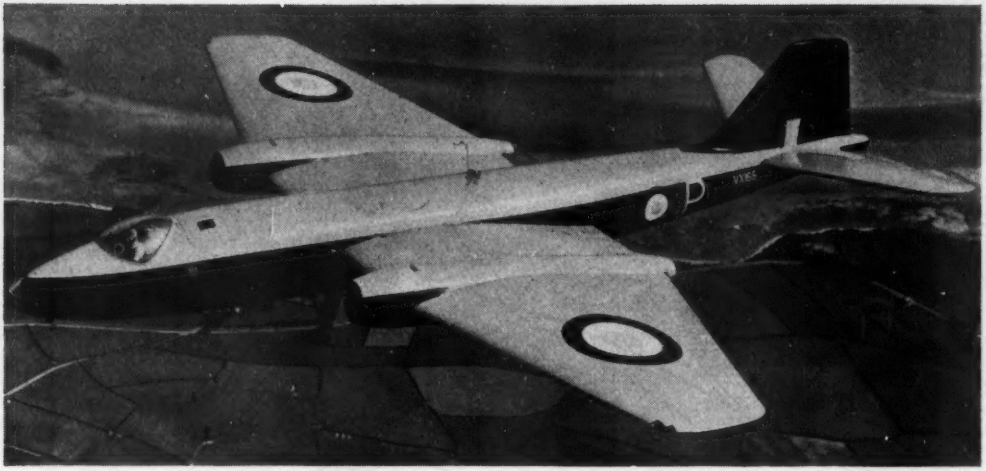

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HERE AND THERE . . .

Adenauer, the Federal Chancellor, promised to assist in finding alternative targets on the sandbanks of the North-West German coast.

Air Aid to Road Safety

IN connection with the grim road-casualty figures announced last week—201,325 people killed or injured in Great Britain in the latest twelve-month period, the highest figure since the war—a sensible idea attributed to Western Air Lines may appeal to British airline operators. Recognizing the exhilarating effect of flying, the American company reminds its passengers to "Drive carefully when you leave the airport." Admittedly, of course, the suggestion might have less value here, where the majority of passengers use airline coaches.

Benelux Meteors

THE Fokker company has clarified the information based on a Hawker Siddeley Group statement and contained in a paragraph, "Belgian-built Meteors", in *Flight* of February 23rd. It is pointed out that Meteors will not be *produced* in Belgium, and that the agreement mentioned only concerns the *assembly* by Fairey, at Gosselies, of major components manufactured by Gloster and, at a later date, by Fokker. The contracts for these new orders were signed by Gloster and Fokker with the Belgian government. Thus, there has been no encroachment on the principle of the Benelux agreement to manufacture Meteor airframes in Holland and Derwent turbojets in Belgium.

North Atlantic Air Power

AMID the controversy surrounding the proposed appointment of Admiral Flechteler as Supreme Commander of the North Atlantic Fleet, the equally important question of relegating control of Western air power has passed relatively unnoticed in Britain. Reports indicate that the strategic bombing forces of the North Atlantic Treaty nations will come under the command of Lt.-Gen. Curtis LeMay. Now the commanding general of the Strategic Air Command, U.S.A.F., this 44-year-old pilot is a likely choice for the post, in view of American predominance in the bomber strength of the Western nations.

It is suggested also that Gen. Lauris Norstad, head of the unified U.S.A.F. command in Europe, may be appointed Allied Air Commander, Western Europe. Bearing in mind the R.A.F.'s major contribution to Western Europe air power as it stands today, and the fact that Western Union air forces employ our methods of training and tactics, many will feel that this post should go to an R.A.F. officer.

FAST FRENCHMAN: New view of an interesting French research aircraft—the S.E. 2410 Grognard, twin-Nene experimental forerunner of the two-seat S.E. 2420. Powered by two Nenes, Tays or French Atar turbojets, the later aircraft is expected to serve as a night fighter or light bomber.

IN BRIEF

MR. ROBERT BLACKBURN has accepted an invitation to become chairman of the Aircraft Golfing Society for 1951. The Society's opening competition takes place on March 17th at the Mid-Herts G.C.

* * *

Hawker Aircraft, Ltd., have again placed Langley airfield at the disposal of the Northern Heights Model Flying Club for their annual gala day, which, it is now announced, is to take place on June 24th.

* * *

The Royal Pakistan Air Force has ordered from Marconi's Wireless Telegraph Co., Ltd., three AD.200 V.H.F. direction-finders for use on airfields in Pakistan. The AD.200, a navigation aid for ground installation, provides instantaneous bearing indication of two aircraft transmitting simultaneously on different frequencies in the 118/132 mc/s band.

An exhibition illustrating every aspect of the petroleum industry's work is to tour London, Glasgow, Leeds and Cambridge Universities. Organized by Shell and Anglo-Iranian, it will be at the Imperial College of Science and Technology from April 6th to 21st.

FOR HIGH ALTITUDES: This neat time-delay switch is being used experimentally in high-energy igniter systems on two types of a well-known British jet fighter. Venner Time Switches, Ltd., New Malden, are the makers.

Anglo-Iranian Oil Co. (Malta), Ltd., has changed its title to "B.P." (Malta), Ltd.

* * *

Miniature Bearings, Ltd., whose range of very small bearings was recently mentioned on this page, state that they have been British distributors since 1933; as the result of the lifting of import restrictions, however, the bearings have only recently become freely available.

* * *

At the annual general meeting of H. M. Hobson, Ltd., Mr. T. P. Searight (chairman) said that the company's year had been more favourable than had been expected. The new foundry was in full production, and had been of great assistance in producing the highly complex castings required. Integral, Ltd., the Hobson subsidiary company, continued to do well.

HEARTENING SPECTACLE: Gloster Meteor 8 intercepters (two Rolls-Royce Derwent) ready for delivery to the Belgian and Dutch Air Forces. They are seen in front of the Fokker hangar at Schiphol airport, in company with three Fokker S.11 trainers, one wearing Dutch Air Force markings. Details of Benelux Meteor production and assembly are given in a paragraph above.

ATOMIC POWER for AIRCRAFT

A Start Made: Possible Influence on Aircraft Design

RECENT guarded announcements made in America regarding progress with nuclear power units have given rise to a great deal of speculation and some fantastic guesswork. There is, however, a little to be learned which seems to be based on fact and which provides food for thought and discussion. Writing in the *New York Times*, Mr. W. L. Lawrence gives an interesting factual account of the picture, so far as it can be generally known at present, together with "guestimates" about the performance of atomic-powered aircraft and submarines.

Project N.E.P.A. (Nuclear Energy for Propulsion of Aircraft) is the name given to a research effort jointly conducted by the Atomic Energy Commission and the United States Air Force. Ambiguously reported in many quarters, the announcement made after four years of work apparently indicates that important progress has been made and a stage reached where theories and deductions can begin to be transformed into design studies with a view to subsequent building of an atomic power plant for aircraft. No time is quoted other than a vague "several years." General Vandenberg has, however, stated publicly that atomic flight is closer than most people realize.

Ten firms have been concerned with the first phase of N.E.P.A's work, and of these the Fairchild Company of Hagerstown, Indiana, is the "prime contractor." The General Electric Company enter into the next phase with engine research and constructional work in view, while the Consolidated Vultee Aircraft Corporation has been named in connection with design-studies for the aircraft, to use atomic power units.

Any atomic power unit devised will almost certainly be based upon one of the familiar types of heat engine, the atomic heat energy taking the place of conventional fuel-burning. The likelihood is that turbines will be involved in some designs, particularly if subsonic aircraft speeds are in mind. Steam and gas turbines are possibilities, but, to avoid the carriage of weighty agents, the closed-cycle type of engine seems to make a claim for particular attention. In America it has been suggested that a metal-vapour closed-cycle unit is a possibility; for example, mercury and its vapour might be used in place of the familiar water and steam system.

Another American calculation regarding fuel consumption is that 1 lb of fissionable material such as U-235 (of atom-bomb fame) should produce enough energy to propel a B-36 for about two million miles. This is just as well read in conjunction with another statement that to give a 100 h.p. equivalent output a protected atomic power unit would at present have to weigh about 50 tons. Considering the B-36 again, if full fuel load and ten engines together weigh 100,000+50,000 lb (75 short tons, in round figures) and produce 40,000 equivalent h.p., then a power: weight ratio of 2 h.p./ton for an atomic unit is of little help even if the fuel load is measured in fractions of ounces.

Returning from the realms of conjecture, the three subjects which now have to be explored further before practical results can follow are: (1) control of atomic fission—in one sense provision of a power lever for the atomic engine; (2) the method of converting the atomic heat energy into propulsive thrust; and (3) the shielding of crew (and passengers) from the effects of atomic radiations.

All these problems can, of course, be tackled much more easily in ships, and it is reported that work has already been started on the design of an atomic power unit for trial in an experimental submarine.

The effect of such a new source of propulsive energy on aircraft design can only be the subject of a guess guided by a few known requirements. There will, presumably, be two main classes of aircraft or missile; one carrying a human crew, the other pilotless. A subdivision of the man-carrying class might be made between sonic and subsonic designs. Certainly no airscrew-driving application of atomic energy is likely for aircraft designed to fly above the high subsonic speeds. For the others the atom is likely to provide thrust from heat energy more directly, as in the athodyd.

Common to all but the pilotless missile may be the need to keep crew and passengers well away from the atomic power source. Thus, aircraft following (for aerodynamic reasons) the normal lines of development foreseen with existing prime movers may also exhibit exceptionally long noses or tails, power plant and cabin being located, so far as possible, at opposite ends. The *canard* tail-first layout might be applicable here, the bulk of the aircraft and the mainplanes being well aft and the cabin and "noseplane" well forward. Another possible layout would be assymetric, with cockpit and/or cabin well towards one wing-tip and the power unit on the other side.

The possibility of arranging for the entire power unit and its protective casing to be quickly removable for servicing and replenishment is foreseen in America. Freighters with detachable hulls or hold sections are already quite familiar, and these may give a lead towards possible schemes for detachable atomic power plants. Such an arrangement would have the additional merit of reducing any dangers from atomic radiation to servicing crews concerned only with the airframe, to airfield staff and to other aircraft which might be parked nearby.

For the usual reasons, all ultimately concerned with cost, aircraft with atomic power will almost certainly be built and used for military purposes long before a commercial application is found.

SIMPLE STALL WARNING

PRIMARILY for use on light aircraft—and for those who consider such aids desirable—a simple stall-warning device that requires no electrical supply is the subject of a patent application by Mr. C. P. Goodwin, of 12 Market Place, Falmouth, Cornwall.

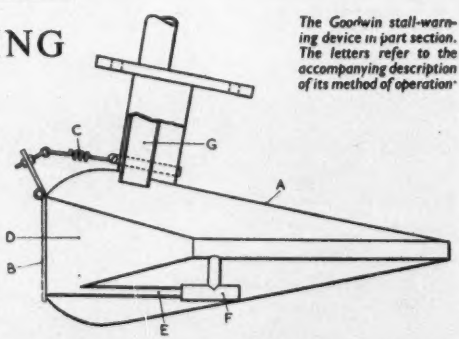
Intended to be fitted in any position affording uninterrupted airflow, the apparatus consists (as will be seen from the diagram) of a streamlined casing (A) carrying at its forward end a hinged flap (B) which, though loaded towards a partly open position by an adjustable-tension spring (C), will be kept closed by the airflow at normal flying speeds.

Should speed fall below the critical point the flap will open, allowing air to enter a venturi tube (D) and also the open end of a secondary tube (E). The latter leads to the pressure-side of a whistle (F), the exhaust aperture of which communicates with the narrow section of the venturi.

In these conditions the whistle will sound; conversely, the sound will cease as soon as flying speed is regained and the flap accordingly closes.

A simple communication tube (G), passing through the attachment fairing, would carry the sound to the cockpit. The inventor suggests incorporating the tube in the crew's intercommunication system, but since the Gosport-tube intercom is rapidly becoming extinct, his alternative suggestion of an amplifying element near the pilot's ear would probably be more acceptable.

It is to be assumed that Mr. Goodwin has found from practical experiment that the sound will, in fact, be heard through the intended channels, and not merely be lost within the venturi.



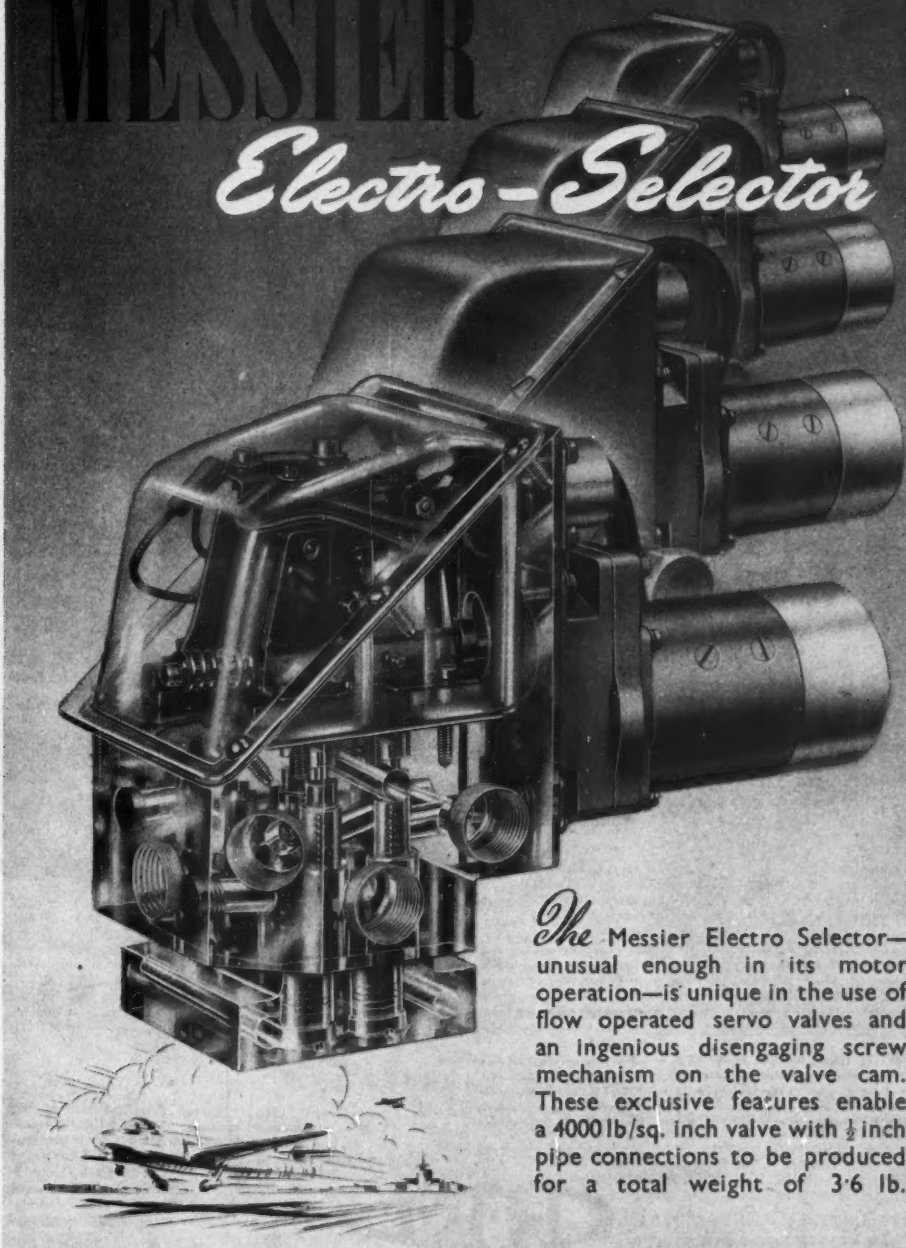
The Goodwin stall-warning device in part section. The letters refer to the accompanying description of its method of operation

Mr. Goodwin also suggests the possible substitution of a small air-driven generator to excite a visual or aural signal, or arrangements for transmitting the signal by electrical, hydraulic and other means.

A cut-off control would be incorporated to prevent the device sounding during fast taxying and it is suggested that this control could be made automatic by connection with, say, the tail-trim.

MESSIER

Electro-Selector



The Messier Electro Selector—unusual enough in its motor operation—is unique in the use of flow operated servo valves and an ingenious disengaging screw mechanism on the valve cam. These exclusive features enable a 4000 lb/sq. inch valve with ½ inch pipe connections to be produced for a total weight of 3·6 lb.

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AIR RESCUE AND SURVIVAL EQUIPMENT

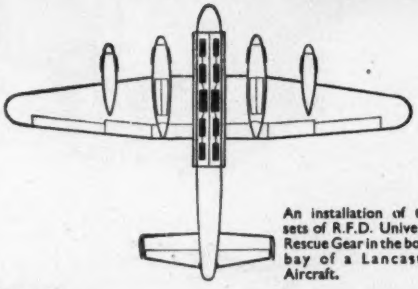
MATÉRIEL DE SAUVETAGE POUR L'AVIATION ET LA MARINE

EQUIPO DE SALVAMENTO AERO-MARITIMO

An Avro Lancaster, having dropped her first set of R.F.D. Universal Rescue Gear, circles as the survivors board the Rescue Dinghy. A second set may then be dropped. The R.F.D. Co. Ltd. manufacture rescue gear for use at sea or upon land, in arctic, temperate or tropical zones, which can be modified for installation in all types of aircraft.

Un Avro Lancaster, ayant lancé son premier jeu de Mat'riel de Sauvetage Universal R.F.D., décrit des cercles au-dessus pendant que les survivants montent dans le petit canot de sauvetage. L'avion peut alors lancer un second jeu de mat'riel. La R.F.D. Co. Ltd. fabrique un matériel de sauvetage pouvant s'employer en mer ou sur terre, dans les régions arctiques, tempérées ou tropicales, et susceptible de se modifier en vue de son installation sur avions de tous types.

Después de haber lanzado su primer Equipo R.F.D. de Salvamento Universal, un Avro Lancaster va circulando mientras los sobrevivientes abordan el Bote Neumático Salvavidas. Entonces se puede lanzar un segundo equipo. La R.F.D. Co. Ltd., fabrica equipos de salvamento para su empleo en el mar o bien por tierra en las regiones árticas, templadas o tropicales, equipos que pueden modificarse para ser instalados a bordo de todos tipos de aviones.



An installation of two sets of R.F.D. Universal Rescue Gear in the bomb bay of a Lancaster Aircraft.

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AIRCRAFT ELECTRICS

Use of High-voltage Systems: A Lecture to the R.Ae.S.

UNDER the title *Progress Towards Electrical Serviceability*, a lecture was presented before the Royal Aeronautical Society on March 1st by Mr. R. H. Woodall, director and chief engineer, Rotax, Ltd., and Mr. W. A. Higgs, head of technical sales (aircraft and automobile equipment), British Thomson-Houston Company.

The authors considered that, technically, aircraft electrical-equipment design had advanced as far as had the associated aircraft or its engine.

The limitation of present-day 24-volt systems, as increased power was demanded, was leading to higher-voltage systems—they were already installed in Hermes, Ambassador and Princess aircraft. Such systems incorporated D.C. generators or alternators with rectifiers, and the merits of these systems would be apparent only after prolonged service life. Both systems retained a substantial 24-volt supply, which was unfortunate, but necessary until more equipment was available for the higher voltage. If the 24-volt supply could not be eliminated, it was obviously important to reduce it to a minimum.

With either of these systems, D.C. utilization was still used, and an all-A.C. system must be developed for the large civil aircraft of the future.

The possibility of obtaining light-weight and reliable constant-speed drives now looked more hopeful, the authors having in mind the work of Gerritsen, Beier and others. A specialist development firm in the industry now had an extensive programme of work in this direction.

Such drives might not reach the desired accuracy for parallel operation of alternators, but would show great advantages with D.C. generators. By reducing the generator speed-range to a very narrow band, it might be possible to save sufficient weight in the D.C. generators to compensate for the added weight of the gearbox.

The ultimate ideal installation would be the use of auxiliary generating plant. The equipment installed in the Shetland was electrically ideal, but the particular auxiliary engine used to drive the generators was suitable for operation only at low altitudes. If a small auxiliary turbine unit could be developed successfully, it should be possible to apply turbo-alternator construction techniques to aircraft alternators. This would mean developing a two-pole 400-cycle alternator running at 24,000 r.p.m., which surely was not an impossible task. Such a system would utilize no D.C. machines at all and any small quantities of direct current required for, say, contactor coils, would be obtained by rectification from the A.C. power.

If an ideal A.C. system was realized, then machine design would be limited first by bearings, and later (if bearings were improved) by insulation. By that time it should be possible to guarantee a life period and to operate on a replacement system. It would be economical to replace all the electrical machines after, say, 3,000 hours, if during that period no attention whatever were required.

More careful consideration was required to the general application of electrics to aircraft. It was not the authors' opinion that electric power was the only type of power that should be considered. When electric power showed obvious advantages—which was often the case—then it should be used and the exact requirements stated, or determined, as early as possible in the development of a new project. In order to gain more experience the electrical industry must undertake very thorough testing of all items under simulated flight conditions. Collaboration with the aircraft manufacturer was always preferable and, if possible, flight testing should be incorporated in the electrical-development programme, although this would lead to expensive equipment and to a prolongation of the development period.

The electrical industry had much to learn from the aircraft industry about methods by which the development period could be reduced. The aircraft firm had the advantage of the glamour surrounding the new project, and usually devoted its entire efforts to one project at a time. The simultaneous development of a large variety of electrical items presented a very difficult problem which must be solved in order to give satisfaction to the aircraft industry.

"BUILT-IN" ARRESTER GEAR

SOME further details are now available of the "harpoon" braking system—referred to in *Flight* some months ago—being developed by the All-American Aviation Company for the U.S.A.F. Air Materiel Command. The equipment—which, in effect, provides light aircraft with built-in arrester gear—consists of a 28in-long, 1¼in-diameter steel tube attached to 200ft of stainless steel ribbon wound on to a hydraulic-braking drum: equipment similar in principle to that used for "snatching" gliders.

Inside the tube is a quantity of rocket propellant, which is ignited just before touch-down, driving the tube from a holder in the rear fuselage into the ground at an angle of 45 deg. The anchoring is made more positive by penetration of both the tube and the cable attachment which links it to the steel ribbon. Smooth braking is ensured by the action of the hydraulic drum, which pays out ribbon under increasing tension. The life of the ribbon is claimed to be at least 100 landings.

The device is intended primarily for use with military light aircraft and gliders. During recent ground tests the assembly withstood a pull of 25,000 lb and a simulated 1-1½ g landing-deceleration of a CG-18 glider.

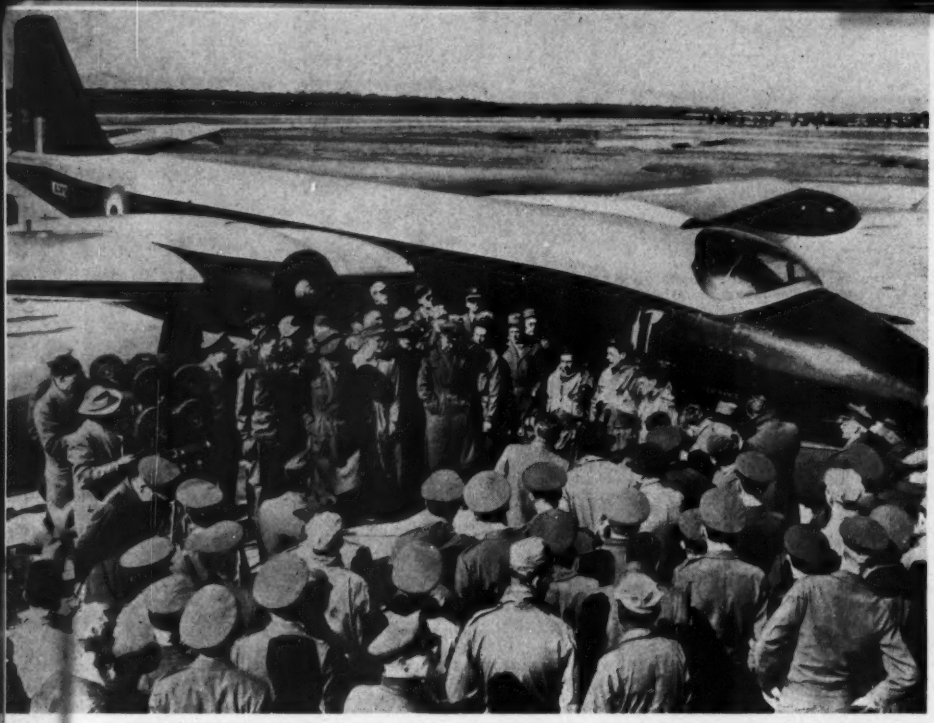
The business end of the device, showing the attachment of the cable which is linked to the steel ribbon from the hydraulically braked drum. The fuselage is that of a Stinson L-5 Sentinel, one of the U.S.A.F. liaison types on which the equipment has recently been tested

CANBERRA RADIO

THE English Electric Canberra which set up the fastest time for a transatlantic crossing on February 21st carried a Marconi A.D. 107 high-power transmitter, A.D. 108 receiver, and A.D. 7092A automatic radio compass. This equipment was originally designed for the use of the British airline corporations, using normal types of aerials, and is reported by the manufacturers to have enabled the aircraft to remain in perfect communication when 1,500 miles out over the Atlantic.

To ensure that the Canberra's performance and manœuvrability are not impaired by the usual protuberances associated with the normal aircraft radio aerials, the suppressed direction-finding loop recently developed by Marconi is employed. The radiator for the high-power communications transmitter is a special type of buried antennæ, designed by the Royal Aircraft Establishment at Farnborough in conjunction with the Marconi company. It is claimed that the use of the suppressed D/F loop in no way reduces the ranges at which good bearings can be taken, and the Canberra's navigator was obtaining navigational aid from the radio compass when the aircraft was 500 miles from the Newfoundland coast.

The Canberra's flight was the first occasion on which the R.A.F. have used the successors to the well tried T.1154/R.1155 equipment which, introduced by Marconi in 1939, became standard equipment for every type of British bomber and flying-boat used during the war. This equipment is still, in fact, fitted as normal on R.A.F. heavy aircraft.



CANBERRA in THE STATES

English Electric Jet Bomber Creates a Stir Among U.S.A.F. Personnel

THE pictures on this page are illustrative of the great interest occasioned by the arrival of the English Electric Canberra B.2 tactical bomber at Andrews Air Force Base, Maryland, after flying down from Gander, Newfoundland. The Canberra's historic transatlantic crossing was duly chronicled in *Flight* last week.

In the topmost view the Canberra's crew face the cameras and microphones, temporarily distracting attention from their much-admired aircraft. On the right, they are being greeted by A. Cdre. Ferdinand Swain, Deputy Chief of the British Air Force Staff in Washington, and Maj.-Gen. Morris R. Nelson, Director of Air Requirements, U.S.A.F.

The unusual angle shot below shows the Canberra's variable-incidence tailplane (a major factor in its manœuvrability and controllability), and is further interesting in showing the lower hatch in use. It will be noted also that the finger-type dive-brakes are extended.

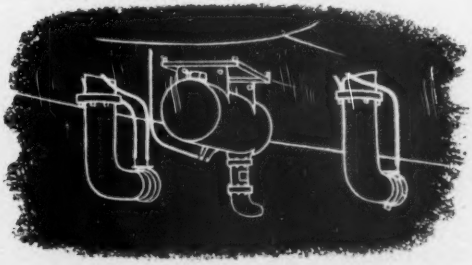
Late last week the Canberra was due to fly to Langley Air Force Base, Virginia, for inspection by the Tactical Air Command of the U.S.A.F.

A FACE IN A MILLION

and, moreover, a face which can be seen in millions. For it's the death mask worn by countless hordes of locusts stricken down by insecticide sprayed from Avro Ansons equipped for pest destruction. This modern way of attacking inaccessible breeding grounds has proved the economy of using *suitable* aircraft.

Compare these operational requirements with . . . . . the Anson facts :

1. Two engines for safety over broken terrain.	*Two Armstrong Siddeley Cheetah engines which are renowned for their reliability.*
2. Manoeuvrability close to the ground.	*The Avro Anson's capabilities have been proved in large-scale spraying operations at low levels.*
3. Ability to operate from strips prepared near the dropping zone.	*At full load the Avro Anson takes off in 550 yards and requires only 300 yards from touch down to stop.*
4. Sturdiness to withstand damage in operations from rough, hastily prepared strips,	*The Avro Anson fuselage, of welded steel tubular construction, possesses great strength and resiliency and is capable of absorbing an unusual amount of severe handling.*
5. Reliability to ensure trouble-free operation away from permanent bases.	*The Avro Anson's reputation for reliability is the outcome of 15 years' service in all parts of the world.*
6. Appropriate insecticide capacity for operations which must be closely controlled by ground observation to avoid wastage.	*Two fuselage insecticide tanks, having a total capacity of 200 gallons, have proved adequate for a coverage of 1,000 acres in a single 20 minute sortie.*



AVRO

ANSON

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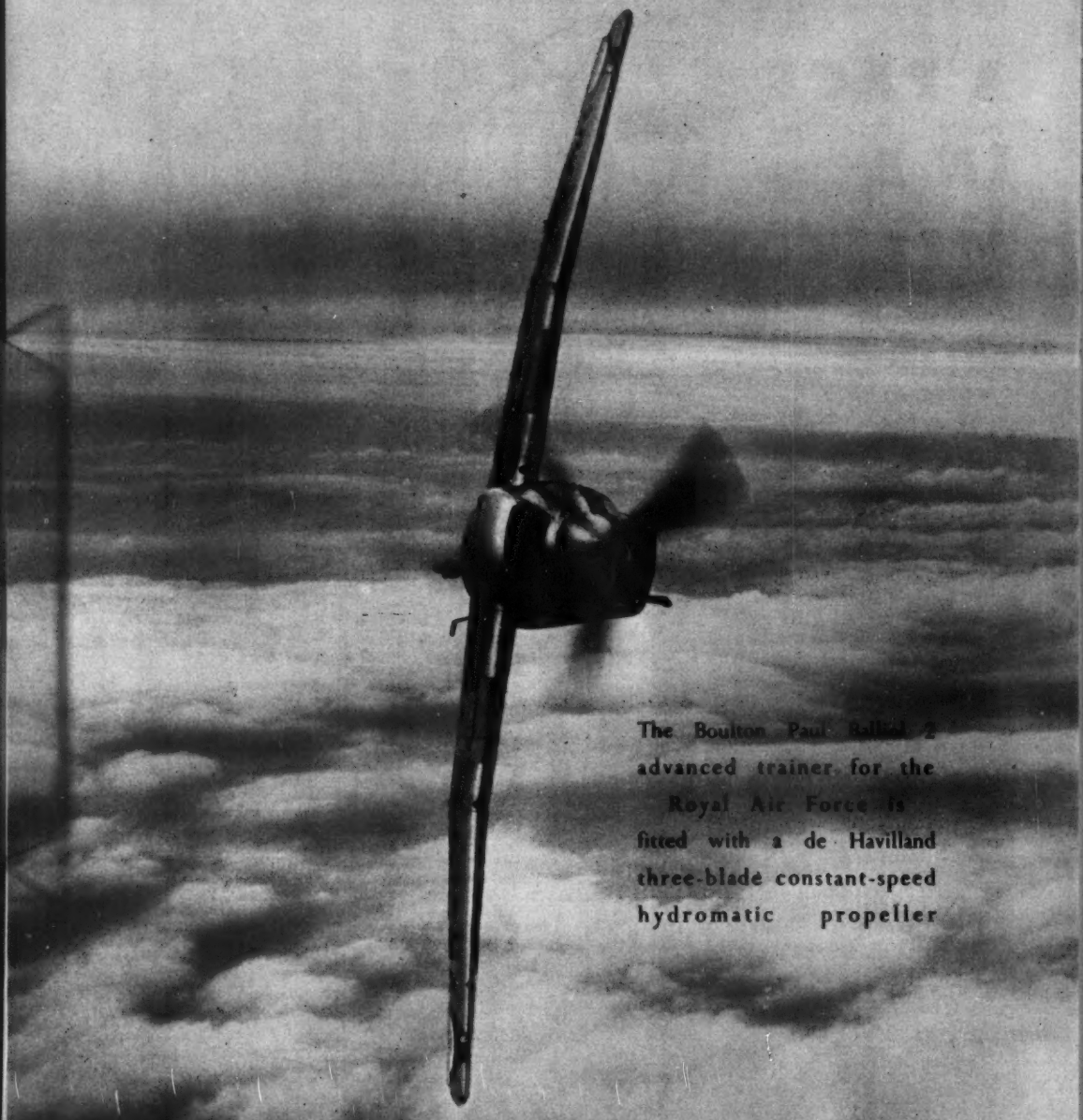
Member of the Hawker Siddeley Group

The choice of experience



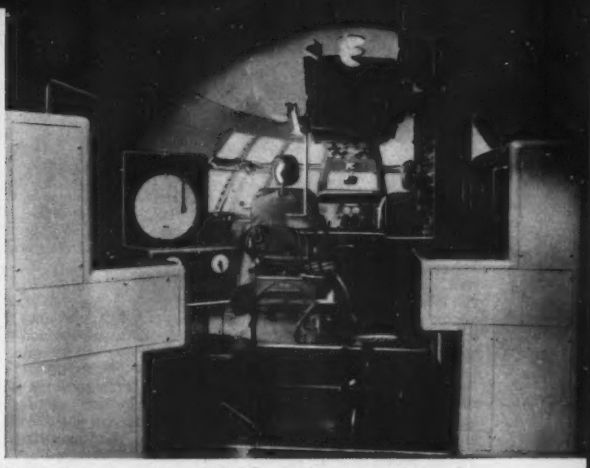
The Boulton Paul Balliol 2 advanced trainer for the Royal Air Force is fitted with a de Havilland three-blade constant-speed hydromatic propeller

DE HAVILLAND PROPELLERS

DE HAVILLAND PROPELLERS LTD., HATFIELD AND BOLTON, ENGLAND

FLIGHT SIMULATOR

A British-built Ground-training Aid for B.O.A.C.



In the simulator are seen standard Stratocruiser crew stations and additional positions and cabinets for the chief and assistant instructors.

FOR many years past, various devices have been designed to help pilots and crews to learn to fly. They have steadily become more elaborate, and during the late war a very large number of synthetic training aids were devised and employed. Not until the last few years, however, has the term "flight simulator" come into use to describe the function of a training machine.

The first British flight simulator, built to the order of B.O.A.C., is nearing completion at the Wandsworth works of Redifon, Ltd.; representing the Boeing Stratocruiser, it closely resembles the Curtiss-Wright simulator conceived by Dr. Ralph Dehmel, and operated at La Guardia by Pan American Airways (see *Flight*, December 8th, 1949).

Synthetic trainers can economically be made more elaborate and expensive as the costs of aircraft operation and crew training mount. To-day, four-engined airliners—or bombers—cost between £200 and £400 per hour (the figure for the Comet may be less) to operate, and thus any machine which can save a percentage of this expense is worth consideration.

It is true to say that the world's major airlines are sold on the idea of flight simulators, and that the American services also regard them as practically indispensable. The R.C.A.F. and recently the R.A.F., have followed approval with action in the form of orders. There is no doubt that electronic flight-simulators will become standard equipment for airlines and the Services, one or more extra cockpit units being ordered with each new type of large or medium-sized aircraft for delivery, if possible, before the first aircraft.

Redifon have been working on B.O.A.C.'s Stratocruiser simulator for about fifteen months following an arrangement made with the Curtiss-Wright Corporation allowing an exchange of technical and other information. As mentioned in *Flight* of February 23rd, the first three months were taken up while a team studied the American product. Next, alterations to suit B.O.A.C.'s special requirements were incorporated in the original plans, and, as the similator was a later design, certain improvements and additions were made.

In a week or two from now, the simulator will be ready to be transported in units to its site at Meadowbank House, Cranford, near Heathrow.

A high degree of realism is achieved in the flight simulator, and crews experience the same atmosphere and instrumentation as they would in the aircraft proper. The machine should, in fact, be approached as an aircraft and not as a trainer. In the simulator syllabus may be included all manoeuvres except those which necessitate visual reference to the ground. The only shortcomings besides the lack of visual reference are the absence of g and yaw effects, which can be regarded as relatively unimportant.

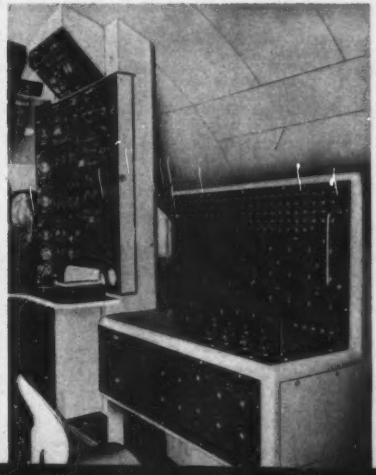
Training on the simulator may be considered in three main sections, of which the first is familiarization with the crew layout and with every control, switch and instrument in the cockpit; the second is familiarization with all normal procedures and flight characteristics; and the third is practice in dealing with every possible emergency so that, as Mr. Scott Flower* has put it, "problems attending emergencies become dependent upon reaction rather than a prolonged thought process."

The simulator incorporates all the standard radio aids together with recorder units, and, therefore, training is not

* *Of Pan American World Airways, Inc.; author of "A Review of a Year's Operation of the Curtiss-Wright Dehmel Flight Simulator," S.A.E. National Aeronautic Meeting, New York, April, 1950.*

(Left). Two recorders positioned on each side of the radio aids unit. Exercises in navigation and communications, and practice with landing aids, are conducted from this station.

(Right). Chief instructor's "troubles panel," from which all emergencies can be sprung upon the crew. Beyond it is seen the crew flight engineer's panel.



FLIGHT SIMULATOR . . .

limited to the mere handling of the aircraft. Practice in navigation and, more particularly, approach and let-down procedures, are among the normal facilities offered by the trainer. At all times the crew under training fly blind, the emphasis throughout being upon instrument-flight instruction. Pan American believe that route-proficiency checks can be given on the simulator, and this form of flying is done almost entirely by the use of radio aids, which are (or can be) reproduced in the simulator. It is suggested that this, coupled with three dimensional pictures of landing areas, will permit adequate round-the-world route-checks to be given without the crews leaving the ground. In addition, it is expected that the simulator will provide a proving-ground for new instruments and devices. Incidentally, accurate instrument representation is given for taxying and the use of nosewheel steering.

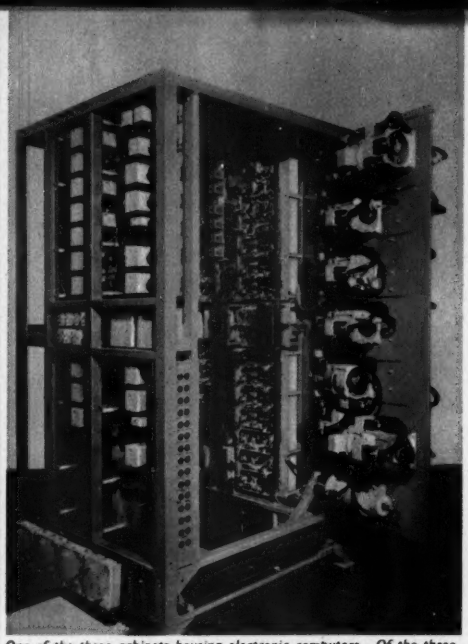
The design of a simulator is based upon data supplied by the makers of the aircraft and relating to aero-dynamic and handling characteristics and to the power plants. The information is translated into electro-mechanical values, and all the control movements and forces are presented to the crew as readings on the various flight, power plant and navigational instruments. Realism is ensured by the proper control-column loadings and aural effects.

After translation, the data from the aircraft manufacturers are designed into servo units incorporating key components known as contour potentiometer cards and actuated by amplifiers. Each unit may be regarded as a computer which is continuously solving with precision the numerous differential equations expressing the movements of the aircraft in space, the factors for which are fed in from signals which originate with the movement of the flying and engine controls. The power-supply cabinet for the three computer cabinets converts power from an outside source into whatever voltage is needed. In the original Curtiss-Wright Pan American equipment the requirements varied from 320 volts D.C. to 2.5 volts A.C.

The widest limits of aircraft performance can be simulated: for example, power conditions with two or more engines running with an output range of zero to 3,750 b.h.p. each; indicated air speed from zero to 406 m.p.h.; altitude from zero to 32,000ft (temperature and density vary at standard lapse-rates); gross-weight conditions from 80,000 to 140,000 lb; and centre-of-gravity limits beyond those actually permitted on the aircraft.

A standard layout or building devised for the simulator is seen to comprise a large room containing the complete model crew-compartment of the aircraft; a smaller semi-air-conditioned room beside it containing three computer cabinets and an electric supply cabinet; and the chief instructor's office, which communicates through the briefing room with the simulator compartment. The simulator itself is entered through a bulkhead door from the briefing room.

Illustrated on page 283 are the various units contained in the simulator crew-compartment. Of particular note is the

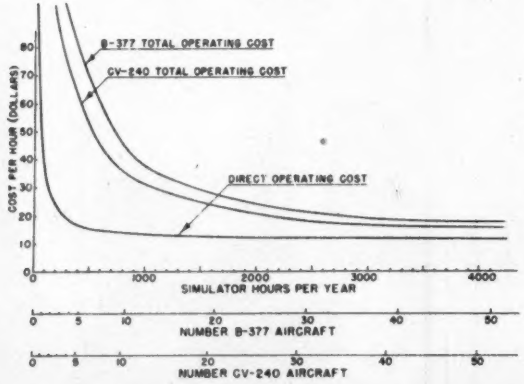


One of the three cabinets housing electronic computers. Of the three, one is for flight controls, another for engines Nos. 1 and 4, and the third for engines Nos. 2 and 3. A fourth cabinet is for power supply.

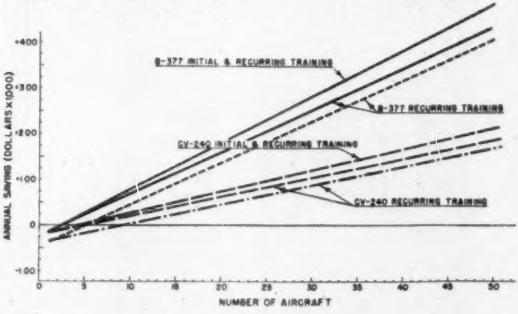
chief instructor's "trouble panel." With the aid of its controls, all kinds of failures and emergencies can be enacted in order to study the crew's reactions. Also additional to the equipment of the aircraft proper are the units concerned with radio aids and recording. One can be set up to correspond with radio aids and other facilities in the vicinity of an airfield at which an exercise might be started, while the other could be set up for conditions at the terminal airport. Between the two recorders is the panel for all radio conversations.

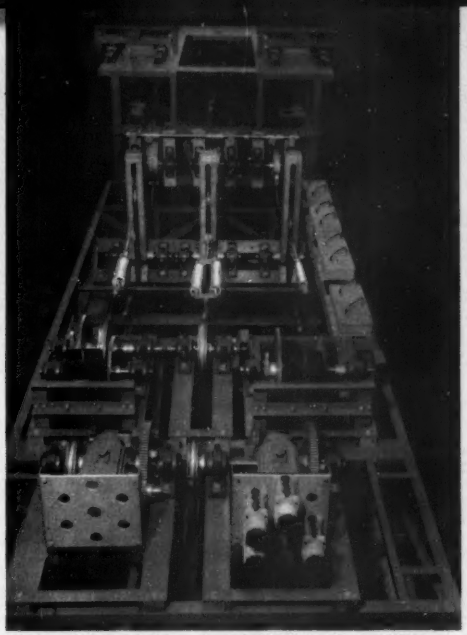
Until B.O.A.C. have operational experience with their own simulator precise figures cannot, of course, be given, but they should prove to be very similar to those compiled by Pan American Airways at La Guardia. Extracts from the P.A.A. syllabus show that a full training course for the captain, first officer, and flight engineer of a Stratocruiser calls for 35 simulator hours, divided into 16 periods. Pilot and co-pilot do 15 hr each at the pilot's station, plus 2½ hr each at the flight engineer's station. The first 3-hr period is concerned with familiarization; the next three 2-hr periods with handling and procedures; drills (mostly fire) and instrument approaches follow, for captain and first officer, in two more 2-hr periods. Then four 2½-hr sessions are arranged with an interchange of positions between engineer and pilots,

Operating costs for the flight simulator. Initial cost for the Stratocruiser (B-377) simulator is taken as 250,000 dollars and for the Convair 240 simulator 175,000 dollars. The amortization period is taken as ten years in each case.

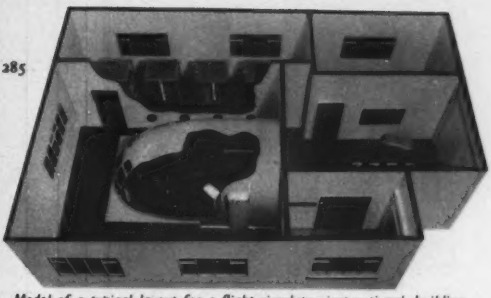


Graphic representation of simulator annual savings plotted against number of aircraft in a fleet (P.A.A. figures). Curves are given for the Stratocruiser and Convairliner. The lower curve of each group is for five-year amortization; the upper two for ten-year amortization.


B-377 INITIAL & RECURRING TRAINING
B-377 RECURRING TRAINING
CV-240 INITIAL & RECURRING TRAINING
CV-240 RECURRING TRAINING
ANNUAL SAVING (DOLLARS X 1000)
NUMBER OF AIRCRAFT



What may be termed the mechanical side of the simulator is shown in this photograph of the control loading frame. The slides supporting the pilots' seats are just visible at the top of the picture.



Model of a typical layout for a flight-simulator instructional building. Surrounding the simulator itself are the computer room, briefing room, chief instructor's office and entrance lobby.

and a revision of standard procedures and drills. The final six 2-hr periods are devoted almost entirely to flight problems set by the chief instructor from his "troubles" panel, and final checks for captain and first officer.

In addition to this first course, bi-annual flight checks, each of which used to occupy some four hours of flying in the aircraft, now take six hours in the simulator.

Experience has shown that without the use of a simulator approximately 21 flying hours are needed to convert a crew to a new four-engined aircraft, but with the aid of a simulator no more than eight hours, and on occasions as few as four, have proved to be enough.

It is not proposed here to discuss costs in great detail, but the two Pan American curves on the opposite page, showing operating costs and annual savings, provide much of the information which may be required.

Flight simulators are usually built for a ten-years life. Operational costs for the Redifon machine will be approximately £30 per hour (as compared with £300 for a Stratocruiser). Thus, if a reduction of about 60 per cent in actual flying time devoted to crew training and checks is possible, B.O.A.C., with some 35 Stratocruiser crews, will effect a great saving. The cost of the complete training of one crew will be reduced by about a half. The simulator will also be hired out to other airlines, and it may pay for itself within the first two years. It is understood that P.A.A. were able to clear the cost of their B-377 simulator in about eighteen months.

Regarding maintenance and utilization, in one 12-month period, the La Guardia simulator operated for 2,750 hours of training in 3,300 hours of total operating time (the difference being made up by continuous running between classes, demonstrations to airlines and visitors, and a few hours for maintenance and calibration work). In that period only five hours of training were cancelled due to breakdowns.

Two maintenance engineers are required to work in shifts. The bulk of their work comprises inspection, cleaning, testing and minor adjustment, most of which can be accomplished during normal operation—of 12 to 16 hours daily.

In calculating costs, no account has been taken of the salvage value of components of a superseded simulator.

INFALLIBLE GLIDER

AN engineer (who in his youth had been a "bug-hunter") stood on a mountain crest in Malaya, prospecting for a road. Below him was a little valley, where grew tree-ferns like palms and yellow rhododendrons. His attention was fastened on what seemed to be an unfamiliar butterfly down in the valley; it was not its colouring that was striking but its curious, lilting flight.

As he watched he saw that it was meandering up the hillside and would cross the ridge near by. He ran to get a closer view; and as it passed twenty feet overhead, he threw his hat at it. By great good luck he brought it down and discovered it was not a butterfly at all, but an extraordinary gliding seed.

Many seeds are great aeronauts. They balloon, parachute, rocket and auto-rotate; but only this one actually glides. The specimen caught by the engineer on the mountain at an altitude of six thousand feet was still rising. Being a glider of perfect performance, at such an altitude it might well have covered hundreds of miles. These seeds have, in fact, been seen flying over ships six hundred miles from land.

Its botanical name is *Macrozanonia Macrocarpa*. It is a kind of climbing gourd that grows in the jungles of the Malayan Archipelago and is about as large as a football. Each seed, very flattened and approximately the size of a shilling, is embedded at the centre of a diaphanous filament of half-moon shape; these filaments lie within axial planes, like the pips of an orange. When the fruit decays it falls apart and the hot sun dries the filaments, which then float away on the breeze.

Each filament is semi-transparent and has a silky sheen, which glimmers silver and gold in the sunlight. Its wing-thickness is delicately graded so that the margins, including that of the leading edge, are flexible. About six inches in span, it is of the tailless or pterodactyl type. The flexible wing-tips act as automatic stabilizers.

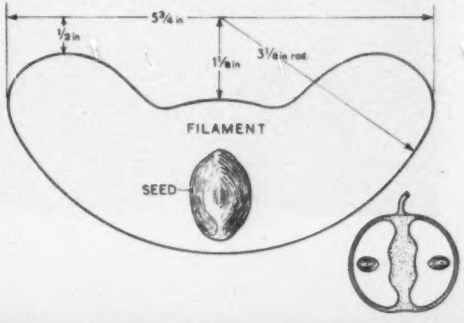
In performance this glider is infallible. Nothing one can do prevents it from automatically resuming its flying attitude. Its progress is as follows: a nose-dive flattening out into a gentle glide; then a climb to a stall (a tail-slide is prevented by the flexible trailing-edges); the nose dips and the process repeats itself.

It can be released from the hand head-first, tail-first, or with wing-tips pointing vertically down—in fact, released anyhow—and immediately it becomes stable and goes sedately on its way.

To-day, the gliding flight of birds is commonly understood, but not long ago it was believed to be by virtue of some mysterious power; so the early inventors of flying machines concentrated on the principles of wing-flapping. Had Leonardo da Vinci been able to handle and study one of these gliding seeds man's conquest of the air might have come sooner.

JULIAN ALLEN.

[A specimen of this remarkable fruit and its seeds—now, we are informed, re-classified as *Alsomitra Macrocarpa*— is displayed in No. 3 Museum at Kew Gardens.—ED.]



"General arrangement drawing" of the seed and (below) the gourd.

ACCIDENT INVESTIGATION

How causes are found and cures applied: A. Cdre. Vernon Brown's Lecture to Licensed Engineers

Found three miles from a crash, this piece of plastic material pierced by a splinter of wood gave the clue to the cause—an airscrew breakage.

THE investigation of aircraft accidents is sometimes apt to be regarded by the uninitiated as merely another instance of Officialdom's desire to pry, interfere, prepare memoranda and give employment to large staffs. In actual fact, as most readers of this journal are aware, it is a valuable and rewarding science and one which has undoubtedly been the means of saving a great many lives and much valuable property.

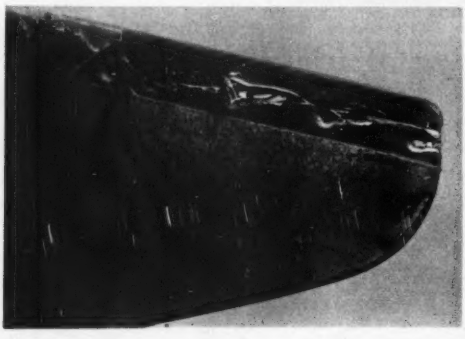
Some of these positive results, and the methods by which they are achieved, were lucidly explained by the Chief Inspector of Accidents, A. Cdre. Vernon Brown, C.B., O.B.E., M.A., F.R.Ae.S., R.A.F. (ret.), in a lecture to the Society of Licensed Aircraft Engineers, given in London on February 24th. A summary of his paper follows.

After defining an "accident" as opposed to an "incident," A. Cdre. Vernon Brown explained the two methods of investigation of civil accidents adopted in this country: (*a*) by his department, and (*b*) by a Court of Inquiry. On notification of an accident to the Minister of Civil Aviation, the preliminary particulars are quickly obtained in order that a decision may be given as to whether an investigation of any kind is, in fact, required. If the answer is in the affirmative, members of the Chief Inspector's staff* go to the scene and collect all possible evidence. A preliminary report is then prepared and the Minister decides whether (*a*) an ordinary investigation or (*b*) a Public Inquiry should be held. In the meantime, if the evidence suggests the necessity of introducing immediate safety measures, the appropriate departments are advised.

If the Minister decides upon an investigation he advises the Chief Inspector accordingly. The analysis of the evidence is continued, and the investigation is considered complete when the Chief Inspector has made his report to the Minister. If blame is to be attributed, then certain requirements must be observed to ensure that the legal position of those involved is duly safeguarded. The Minister also decides whether a report should be published—as in the case of those accidents on scheduled or charter passenger flights from which useful lessons are likely to be learned—or merely made privately available to any interested persons requiring information.

Commenting on what sometimes appeared to be unnecessary delay in setting up a Court of Inquiry, the lecturer reminded his audience of the inevitable difficulties attendant upon nominating a president, assessors and counsel. He went on to explain that, as head of the Accidents Investigation Branch of the M.C.A., he was directly responsible to the Minister. "I would like to emphasize," he said, "that no Minister has ever exercised pressure on me of any kind whatsoever, and that I have always been left free to express my views without fear or favour. The A.I.B. has, in fact, been treated as if it was independent of the Ministry."

Certain accidents that resulted from wooden-airscrew breakages were found to be due to failure in the region of the blade-tip sheathing.



Discussing investigation methods in detail, the air commodore showed illustrations of the extreme types of wreckage that might be encountered, varying from an aircraft that had fallen in a flat spin and suffered comparatively little damage, to high-speed crashes and to mid-air structural failures which might spread wreckage over miles of countryside.

Since the clue to the cause of the accident very often lay in the wreckage, it was most important that, before the investigators arrived, the crash should be properly guarded against souvenir-hunters or crowds who might tread wreckage into the ground and, incidentally, obliterate impact marks.

To show that vital evidence was not always discovered in the wreckage itself, the lecturer illustrated a small piece of plastic material found nearly three miles away from a crash; in it was embedded a splinter of wood. The plastic material was identified as part of the nose of the aircraft, and the splinter as coming from the airscrew, thus indicating that an airscrew breakage had been the primary cause.

A. Cdre. Brown then went on to show various examples of metallurgical failure, and explained how fatigue failures could usually be distinguished, by a trained engineer, from breakage as a result of the crash impact. Wood failures, he said, were a study in themselves; and the fibres often gave a clue as to whether failure occurred in tension, compression or bending.

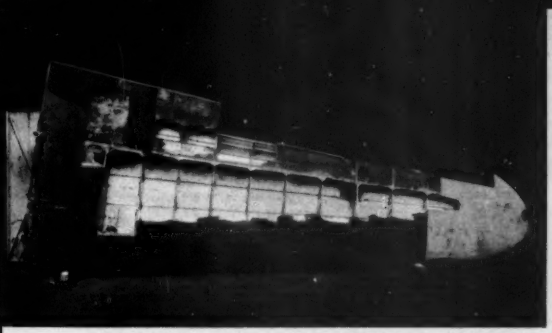
Glued joints formed a special study, and although the A.I.B. could generally be sure if a joint had been badly glued, they preferred to seek diagnosis from specialists.

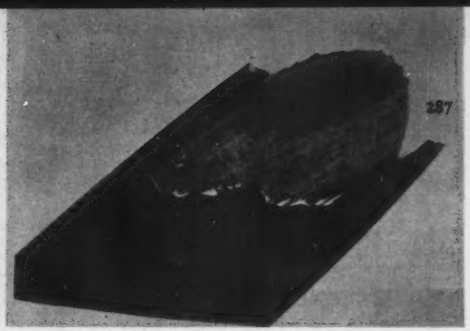
Experience usually showed what various marks on wreckage indicated. For instance, damage caused by a bird striking a leading edge could usually be easily identified by the presence of feathers or blood. Sometimes the tailplane might be damaged by a heavy object such as a dinghy-inflation bottle (during the war a series of accidents had occurred through dinghy-compartment covers coming adrift); in another case, a tailplane was found at an isolated position in the wreckage trail, and showed some peculiar damage that could not be reconciled with the fact that the tailplane had fallen upon grass; it was eventually found that one of the undercarriage doors mated perfectly with the damaged area, showing that the door had come off in flight.

The examination of wreckage was, of course, only one of the A.I.B.'s tasks. Background information was always required, such as the nature and history of the flight, weather conditions (forecast and actual), briefing details, crew histories, aircraft documentation and loading, navigational and other aids carried, ground aids available, and so on. Because human error might be closely bound up with technical factors, their relationship had to be carefully examined; nor must the investigator forget the possibility of crew fatigue, perhaps contributed to by noise, vibration, temperature or inadequate cockpit lighting. It might, therefore, be very important to obtain evidence from survivors, though much delay might occur before a survivor was well enough to be interviewed. Other delays arose from the necessity of making laboratory tests on parts of the structure.

The lecturer then went on to give a number of examples—from an earlier paper he had read before the R.Ae.S.—on the beneficial effect of accident investigation on aircraft design. He instanced the use of slats as an anti-stalling measure. While they had been effective many years ago on the smaller types of aircraft,

* *The staff, explained the lecturer, consists of Inspectors, who have a practical flying background, and Investigators, who are primarily engineers.*





(Left) *An example of failure which was not due to ground impact, but occurred in the air : stripping of a plywood wing skin as a result of damage from fitters' boots on a too-narrow walk-way. (Right) A second illustration of blade-failure from centrifugal loads in the region of the tip-sheathing.*

they could be dangerous on larger and faster aircraft : people were apt to think of the slat as a device which operated according to flying speed, whereas actually it opened as a function of the angle of attack. The result of such a misconception could be serious damage to the mainplane, or perhaps its complete disruption, when the slat moved forward violently during some high-g manœuvre.

As regards skin failures, cases had occurred of a plywood mainplane top-skin coming off in the air, and in a certain type of aircraft they were traced to the use of an insufficiently wide tread-mat, which had permitted fitters' boots to damage the surface. Enlargement of the mat and a strengthening of the wing in this region put an end to the trouble.

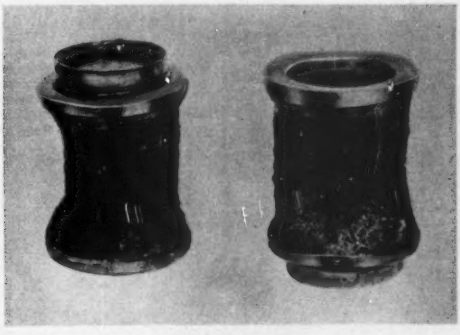
During the war, a large number of structural failures in a certain fighter type were traced to aileron instability, and it was recommended that an up-float limit should be introduced, and that the control-cable circuit should be accurately tensioned. An improvement in the accident rate for this type—from one in 16,000 hours to one in 82,000 hours—followed the implementation of this requirement.

In the past, locked controls had caused many accidents. In one case, an aircraft which had been completely destroyed by fire after impact was found to have the aileron locking pin still in its locked position in the rod between the control-wheel sprocket chain and its under-floor attachment; and this evidence remained in spite of the fact that the control casing had been entirely burned away. Accidents of this kind were now guarded against by the introduction of nuisance bars or other foolproof devices.

Examination of wreckage had also shown up various weaknesses in wooden-airscrew construction, especially as the result of centrifugal loads in the region of the tip-sheathing, in conjunction with too-thin or too-dry glueing. The majority of such accidents resulted from failure of a scarf-joint after a new tip had been fitted. Modification of assembly and repair processes reduced such failures to insignificant figures.

Enumerating a surprisingly large number of ways in which carbon monoxide had entered cockpits and incapacitated the pilots, the lecturer said that nowadays fume-checks were carried out on every prototype aircraft, and percentage checks made on those coming off the production line; since 1943, there had been no record in the A.I.B. of any accident from this cause. In earlier days, also, carburettor icing had caused many accidents, which had included a forced landing by an Empire flying-boat in the Atlantic; here again, subsequent design requirements had virtually effected a complete cure.

Cause of engine stoppage and a crash : oil filters so choked with carbon that the gauze has begun to deform under the fluid-pressure.



A very important part of the A.I.B.'s duties was the investigation of aircraft fires, though when wreckage was burned-out the chances of finding the primary cause of the conflagration were somewhat remote. In crashes, hot exhaust systems and broken electrical circuits were among the commonest means of igniting inflammable fluids. The whole question of crash fires was receiving continuous attention, which involved a study of the use of inertia switches, skin-deflection switches, and various types of crash-resistant tanks. As regards fires in the air, the general introduction of supercharged engines during the early part of the war made it apparent that no matter whether the fire developed slowly (following, say, a pipe failure) or rapidly (e.g., after a major engine failure) the final result was in most cases catastrophic; collapse of a wing could follow the start of a boosted-mixture fire in 90 seconds. Fires were usually caused by (*a*) major engine-failures causing leakage of oil, hydraulic fluid or fuel/air mixture; (*b*) leakage of fluids through faulty pipes or joints; (*c*) location of pipes too near the exhaust system, or bad location of oil or fuel pressure pipes combined with over-filling of tanks; (*d*) exhaust pipe failure or displacement. A combined report by the A.I.B. and R.A.E. issued in 1943 was given a wide circulation; it illustrated many causes of fires and a number of recommendations were made which were subsequently put into effect. On the work and results of investigations during the war years and afterwards, the British Military and Civil Airworthiness Requirements regarding fire precautions were largely based.

Among design modifications introduced with the object of minimizing fire risk, the lecturer cited sheet steel (instead of light alloy) firewalls, fireproof fuel and oil pipes, introduction of high-melting-point material for extinguisher spray-piping, and the locking of pipe union nuts with stainless steel wire. (In connection with this last point, A. Cdre. Brown mentioned that during the war, many unions were not wire-locked—this was due to a production concession necessitated by the high breakage-rate of 1/16in drills used by female operatives; this size of drill was in very short supply.) Continuing with his review of modifications, the lecturer instanced the enclosure of generator brush-gear and use of flame-trap vents in such components; leak-proof fuel filler-caps; and the sealing of wing roots so that fumes from an incipient fire in the wing could not reach the pilot.

The air commodore said that accidents were not very often found to be due to bad maintenance or inspection. Nevertheless, examples occasionally arose, and he illustrated a petrol cock blocked by cotton waste, oil pressure filters so choked with carbon that they began to collapse (this caused the loss, with 13 lives, of a four-engined aircraft), and blockage of tank interconnecting balance-pipe valves by the slushing compound sometimes used to seal metal tanks (suggesting that the tank had, wrongly, been treated with the valve assembly in position).

There were, said the lecturer, very good reasons for the existence of licensed ground engineers, and he went on to quote some evidence from crashes involving private-owner aircraft. In one instance, a man had built a sailplane; the woodwork was excellently done, but the flying wires, instead of being spliced, were attached by tying knots and securing them with bell-wire. The joint did not fail but, owing to the snatch which resulted from an inability to tighten the flying wire, it broke at the eyelet. At the other end was a turnbuckle fixed directly on the mainplane lug, where the cable was tied in a similar way. The drawing specified 20-cwt cable; on test, it broke at under 6 cwt, and was found to consist of commercial wire washing-line bought at the local ironmonger's.

The lecturer, in his summing-up, said that his department's methods did not involve crystal-gazing or black magic; they worked on principles arrived at as the result of 30 years of experience. There was no easy road to the cause of an air accident, and it was very dangerous to give a quick answer.

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UNITED IS TWENTY-FIVE

A QUARTER of a century ago—on April 6th, 1926—a lonely mail flight from Pasco (Washington) to Elko (Nevada) by a single-engined Swallow biplane of Varney Air Lines marked the beginnings of United Air Lines, a company which, according to the latest I.C.A.O. statistics, now ranks third among the world's major operators in terms of passengers carried.

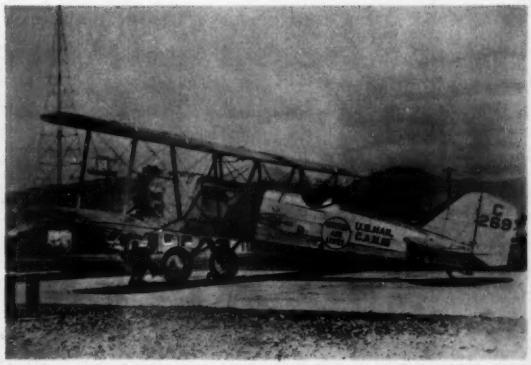
In the ensuing months coast-to-coast air-mail operations were started by several private companies, among them being three more of United's predecessors—Pacific Air Transport, Boeing Air Transport and National Air Transport. For, as its name implies, United Air Lines is a combination of a number of private companies which, although welded together officially as late as July, 1931, were actually enjoying a large measure of active co-operation long before that date.

To one of the group, incidentally, goes the honour of having employed the world's first air stewardess. In May, 1930, Boeing Air Transport signed-on eight young women as an experiment. Although undertaken at the time with some scepticism, the experiment was to prove well justified: to-day there are at least 3,000 stewardesses serving on American airlines alone, 600 of whom are with United.

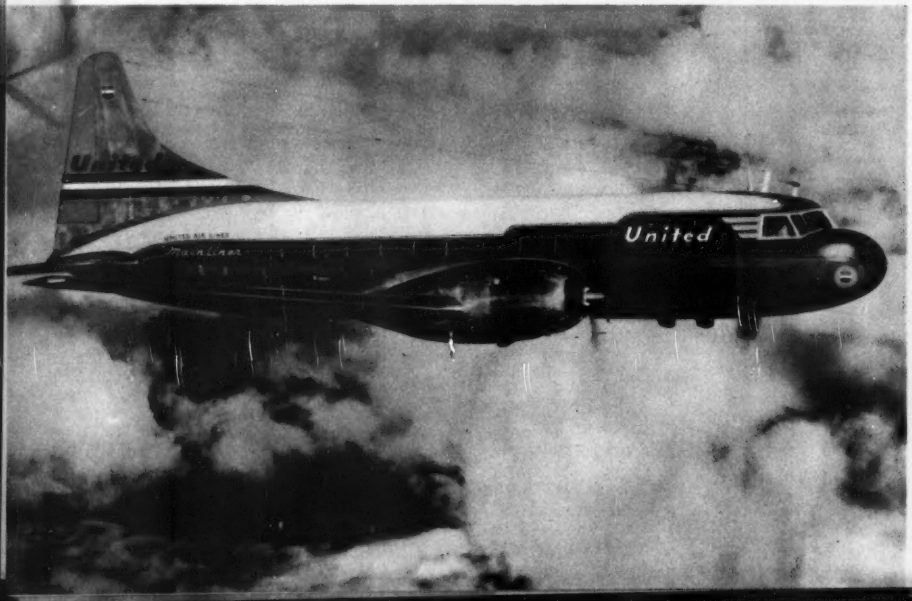
The passage of two-and-a-half decades has seen the change from Swallows and Boeing 40s to DC-6s, Stratocruisers and—the latest equipment on order—the 44-passenger Convair 340s, of which delivery is expected to begin next year. As their silver Jubilee draws near, United Air Lines can look back on a worthy record of achievement. In all, some 15,700,000 passengers have been carried and approximately 600,000,000 aircraft-miles flown, the safety record, too, has been excellent.

United's struggle for prosperity has been as long and bitter, and its share of post-war difficulties as large, as that of any other airline but, happily, success has crowned endeavour. With its "push-button" maintenance bases, such as that at San Francisco, and its policy of continual intensive research into operational problems, the company now enjoys the reputation of being one of the world's most progressive members of a highly competitive industry.

Leon D. Cuddeback, now with the C.A.A., was the pilot on Varney Airlines' first air-mail flight, in 1926. He flew a Model 1924 Swallow Commercial three-seater (Wright Whirlwind with Curtis-Reed airscrew).



A widely used type in the early days of United Air Lines was the Boeing 40-B2, which carried a payload of 1,000 lb. These machines had a cabin with windows which "could be opened for additional ventilation" the pilot was in an open cockpit.



Thirty of these new Convair 340s, carrying 44 passengers and designed to cruise at about 300 m.p.h., are earmarked for delivery to U.A.L. in early 1952. The gross weight is 45,000 lb.

A Mainliner 300 (DC-6), of which United has 39, flies over the famous Golden Gate at the entrance to San Francisco Bay.

In addition to being the third-largest passenger airline, United Air Lines are among the world's leading freight-carriers. In 1949, the last year for which statistics are available, the company carried over 40,000 tons. The aircraft is a DC-4.

Although the "Cargoliner" fleet is composed mainly of DC-4s c number of Dakotas are still giving sterling service. The company has 26 DC-4s and 45 Dakotas, some of which are used for passenger work.

One of the company's seven Stratocruisers lends perspective to the enormous span of the Golden Gate Bridge. The type was first introduced on the Honolulu routes last year.

"Flight" photograph

M. Maurice Roy—a portrait at the reading of the paper.

POWER *versus* WEIGHT

M. Maurice Roy's Louis Bleriot Lecture to the Royal Aeronautical Society: Past History and Present Practice

As we recorded last week, the fourth Louis Bleriot lecture was delivered before the Royal Aeronautical Society in London on February 23rd. The author was M. Maurice Roy, and an English version of his paper—which is summarized below—was read for him by Commandant G. de Fraget. M. Roy is director of the Office National d'Études et des Recherches Aéronautiques; we published a note on his distinguished career on page 249 last week.

The lecturer aroused some considerable surprise by observing that in France, Ader, a Frenchman who conceived and used a steam engine weighing only 6.5 lb/b.h.p., was credited with the first flight of a piloted aircraft—in October, 1897. Having thus effectively secured the attention of his audience, the lecturer then went on to make a power/weight comparison between the 1910 Bleriot and a modern fighter, concluding that the increase in performance was a result of the power/weight ratio having been multiplied by 12 to 15. For commercial aircraft the prime reason for progress was neither operational needs nor passengers' demands for speed; rather was it the need for the best power plants with increased performances.

Turning to aerodynamics, the lecturer discussed the performance—in terms of polar curves of C_L against C_D—of the 1910 Bleriot Mk XI, the transatlantic Bréguet of 1930, a typical modern transport aircraft and an experimental transonic type. From this it was shown that, whilst great progress was made between 1910 and 1930 and between then and 1950, compressibility would introduce difficulties at speeds up to about M = 1.5.

The lecturer then referred to weight-saving in the airframe and observed that, despite the constant increase in performance and size of aircraft during the past 40 years, the structure-weight of nearly all types, even including seaplanes, had been kept down to between 35 and 40 per cent, and this was about the value of the cross-channel Bleriot. It could be assumed that the relative weight of transonic and supersonic airframes of current size and weight would remain at about 0.35 to 0.40, and there was little hope of reducing it appreciably.

Dealing with the trend of wing loading, power loading, and the limit of performance, the lecturer presented a series of statistical charts which, he said, should not be taken too literally but regarded rather as indications of the general trend of aeronautical progress. In terms of the general picture, reference was made to the empirical law put forward by Harold Adams in 1948: this could be expressed as: "In the race towards higher speeds the fighter metaphorically tows the commercial aircraft, with a time-lead which grows slowly but which is of the order of six to eight years." There seemed now to be some slackening in the "tow" and this was probably due to the uncertainty, both in the case of the bomber and the airliner, as to whether the turbo-jet would have a successful rival in the turboprop, or in the compound-engine (foreshadowed, the lecturer pointed out, by Rateau's work as early as 1916). This depended on how much the maximum speed of the so-called strategic bomber could be reduced for the benefit of range, but a bomber could escape the threat of ever faster intercepters only by vying with them in speed, and this made it appear that, after a short period of transition, Adams' empirical law would again prove true, except perhaps for a small class of very long-range aircraft.

The lecturer next turned his attention to what he described as "power-plant effectiveness," and stated that when trying to compare the turbojet with the typical piston engine improved by compounding, or with the turboprop, a criterion had to be found which took into account lightness, compactness and overall efficiency, the speed of flight being a fundamental variable in such a comparison. He chose the criterion put forward for the first time (so far as was known) by L. Laming, and which had been given the name of "effectiveness in flight." This total criterion, E, was the ratio of the net thrust, F, of the machine streamlined by fairings to the total propulsive weight, W_{pr}.

The total propulsive weight, W_{pr}, was the sum of the actual weight W'_{pr} of the engine, fairings included, and the weight W''_{pr} of the fuel and tanks needed to develop thrust F over a distance A, with no wind, under ideal operating conditions of constant speed V and constant height z. By definition, $E = F/(W'_{pr} + W''_{pr})$.

Under the particular conditions defined, and with a lift/drag ratio $f = C_L/C_D$ of the airframe, the relative propulsive weight denoted by w_{pr} was the ratio of w_{pr} to the initial all-up weight W, that is to say $w_{pr} = W_{pr}/W = 1/(fE)$, and therefore was equal to the reciprocal of the product of the lift/drag ratio of the airframe, and the effectiveness of the power-plant. Whereas f was a function of V, of z and of the instantaneous total weight, E was a function of A, z and V.

A propulsive system could conveniently be characterized by curves of E against V for given values of A and z.

With V as abscissa, w_{pr} could be calculated and, subtracting from unity the relative weight w_s of the airframe (i.e., about 0.35 to 0.4), it was also possible to plot a simple diagram showing the relative useful load that could be carried over a certain distance A at speed V and altitude z. Such a diagram was shown in Fig. 1.

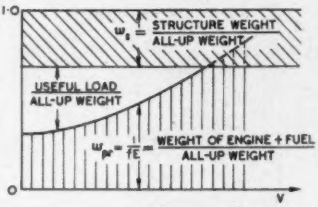


Fig. 1. Diagram expressing relative useful load as a derived function of speed for a fixed height and a fixed range.

Along these lines, and drawing out the basic difference between piston or turboprop engines and turbojet units: (i) the first group was defined by a specific weight ϖ per unit of effective power (in lb/b.h.p.) by an airscrew efficiency η and by a specific consumption μ per unit of effective power and per unit of time (lb/b.h.p./hr), μ including an additional 6 to 9 per cent for the weight of the tanks. (ii) The second group was defined by a specific weight ρ per unit of effective thrust (lb/lb) and by a specific consumption γ per unit of effective thrust and per unit of time (lb/lb/hr).

Expressing A and V in miles and in m.p.h. respectively, the formulae for E in terms of other quantities could be given as:—

Aircraft with Airscrews	*Jet Aircraft*
$E = \frac{375\eta}{\varpi V + \mu A}$	$E = \frac{V}{\rho V + \gamma A}$

As a first approximation, it could be assumed that, for A and z fixed, η, ϖ, μ and ρ were independent of V, the only variable, whereas γ increased linearly with V for a jet, so that $\gamma = a + bV$, where a and b were positive constants.

It was clearly to be seen from the preceding formulae that E was,

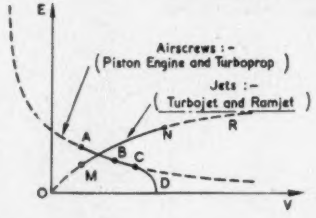


Fig. 2. Power-plant effectiveness expressed as hyperbolic branches derived as functions of speed for a fixed height and a fixed range.

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He stopped; swallowed heavily; turned a slow magenta; agitated his moustaches. Beads appeared on his forehead and froth on his lips. "Water, water" he cried staggering backwards. "On second thoughts —whisky" he murmured faintly. Two yards away stood a man screwing in screws with a hand screwdriver! When our Managing Director had slightly recovered we explained that it was a visiting carpenter repairing a lock.

"Never, never, never" — he said lifting the bottle once more to his lips — "never, never let me see such a sight in my factory again."

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POWER *versus* WEIGHT

in each case, a branch of a hyperbola, although of a very different form in each case, as was shown by Fig. 2.

For airscrew-driven aircraft, the descending branch of hyperbola ABC changed at point C to end on the V axis at point D, where the airscrew efficiency fell to zero. By modifying and improving the airscrew, it was possible to a certain extent to expand the curve of E along the speed axis, but its descent and termination at point D would always occur. In the section AB of the practical speed range, the curve of E did not usually differ much from a straight line.

For jet systems, the branch OR of the hyperbola started from the origin O (the range A having a finite value, the operating speed obviously could not reduce to zero. Point O was, therefore, unreal) and asymptotically approached a horizontal line; the practical range of the curve was a portion like MN. It was seen that AB and MN behaved in opposite ways, and that an increase in V was always favourable to the jet and unfavourable to the airscrew.

Apart from scale effect along the two axes, these features of the curves were the same whatever values A and z might assume. A displacement of the curve MN towards higher values would extend the superiority of the jet engine to wider ranges of operation.

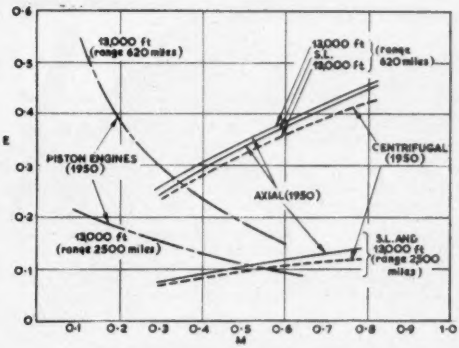

Fig. 3. Comparative propulsion curves for airscrew and jet power units for widely differing ranges.

Having explained the principles of the theory, the lecturer carried it farther by quoting some examples. In Fig. 3 the effectiveness of a modern axial turbojet was plotted against Mach number for ranges of 620 and 2,500 miles at sea level and at 13,000ft. At this altitude, and for the same distances, curves were included for a well-known typical turbojet with centrifugal compressor, and for a piston engine representative of the best modern practice. Generally speaking, the comparison made here between airscrew and jet reproduced clearly the form of Fig. 2. Thus Fig. 3, which was based on reliable data from British and French sources, gave for two widely differing ranges a true enough representation of the comparison between the two modes of propulsion.

It could be noted that for turbojets at the heights and ranges considered, the curve of E was little affected by height. On the contrary, height had a significant effect on the relative "propulsive weight" w_{pr}, already seen to be equal to the reciprocal of the product fE. By increasing the height, the lift/drag ratio f at a given speed was improved, and the higher the speed the greater the improvement.

In subsonic flight, up to about M = 0.85, the polar curve of a given aircraft could be written in the form:

$$C_D = C_{D_0} + \alpha C_L^2$$

where C_{D_0} and α varied only slowly with M, and where the lift coefficient C_L was related to the stagnation pressure $q = 0.5\rho V^2$ by the formula $W = C_L qS$. The reciprocal of the lift/drag ratio could thus be simply expressed:

$$1/f = C_{D_0} qS/W + W/(qS)$$

This reciprocal was a function of speed and height only through the factor q of which f was a simple hyperbolic function.

When the engine and airscrew of a typical aircraft were well suited to flight conditions at a lift near the value for best lift/drag ratio, the optimum conditions of flight for maximum range were at this altitude. It was useful to remember, said the lecturer, that this recognized effect applied not only to aircraft with power plants working at constant specific consumption, but more generally when the specific consumption varied linearly with speed. This was at present the case for many turbojets, at least in the practical range of speeds in which they operated. In the case of the axial turbojet of Fig. 3, for example, this was true from sea level to 50,000ft, and the specific consumption γ was smaller by seven to ten per cent at 50,000ft, so that it was all the more desirable to fly at very high altitude. The curve of E was appreciably above the similar curves shown in Fig. 3, which were almost identical both for sea level and 13,000ft for the two ranges of 620 and 2,500 miles.

The final section of his lecture M. Roy had headed "Towards Hypersonic Speeds," and in this connection the lecturer stated that because of the turbine, the operating temperature of the turbojet (but not its temperature of re-heat) was probably bound to remain lower than that of the ramjet, while the importance of the intake diffuser would increase with speed to the disadvantage of the turbo-compressor. Consequently, the turbojet for ultra-rapid aircraft ought to tend towards a pure ramjet. At lower speeds, the re-heat used to increase the thrust already tended to convert the turbojet into a turbo-ramjet.

However, because of the requirements for take-off and for passing through the speed of sound, the constantly improved turbojet would always be most useful, so that the propulsive system of the ultra-rapid aircraft in the near future would undoubtedly be "a turbojet assisted by a ramjet at its highest speed" rather than "a ramjet substituted by a turbojet at low speeds." So far, everything pointed to the fact that the essential aim of aeronautical progress, excluding guided missiles, was still the improvement of the turbojet which had so recently come into use.

The lecturer observed that it should not be thought that the specific thrust $\Phi = F/s$ of the ramjet (i.e., the ratio of its effective thrust F to the area s of its maximum cross-section) increased indefinitely with speed, or that it was even proportional to the square of the speed, or that it would quickly exceed the specific thrust of the turbojet, particularly the turbojet with re-heat.

Fig. 4 gave a general picture of the comparison between the turbojet (with or without re-heat) and the ramjet. For the ramjet, the location and height of the maximum of Φ (M) depended appreciably on the operating temperature θ_b and on the actual efficiency of the diffuser with normal shock waves or, at higher Mach numbers, with oblique shock waves. In any case, the problem of the diffuser was the same for the three types, and the limitation imposed on the temperature of a re-heat system was the same as that applying to the ramjet.

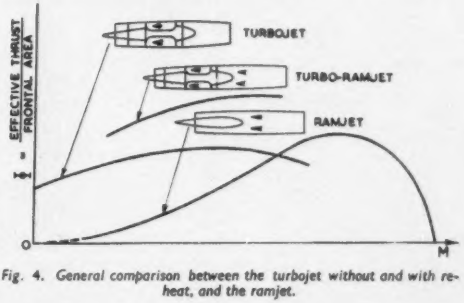

Fig. 4. General comparison between the turbojet without and with re-heat, and the ramjet.

In this connection, temperatures θ_b of the order of 1,500 deg C. were now anticipated; but there were material and structural problems still to be solved, the difficulty of external cooling at very high speeds in rarefied atmosphere had to be taken into account, and allowance had finally to be made for endurance and reliability requirements so that a temperature limited to 1,100 to 1,300 deg C. would still be rather optimistic for some time to come.

To appreciate the effect of this temperature on the specific thrust Φ, and on the overall efficiency η_g of a ramjet with normal shock wave, Φ and η_g plotted against M were shown in Fig. 5 for three different values of operating temperature θ_b, namely, 1,100, 1,300 and 1,500 deg C. Any loss in the intake and exhaust nozzles as well as in the combustion zone had been neglected, which was plainly over-optimistic. The quantity Φ had been divided by the product $0.5\rho a^2$.

The Mach number of the flow at the entrance to the combustion zone, an important parameter, was supposed to be constant and equal to 0.15 in this particular example, which meant that the throat of the exhaust nozzle had to be suited in this case to the Mach number M of flight. It could be seen how much Φ deviated from the "speed-squared" law and how, after a maximum, it fell

POWER *versus* WEIGHT...

off rapidly to zero. The mass-flow evidently suffered from the limitation produced by choking at the throat of the exhaust nozzle.

The overall efficiency of this almost perfect machine did not greatly exceed 0.30 to 0.35, values which were in themselves remarkable, but which would, in fact, be appreciably lower owing to unavoidable losses, particularly those associated with combustion. The lecturer pointed out that the external drag of the faired body, wave drag and friction drag had been included in estimating the effective thrust $F=\Phi_2$. It was important in this connection that the internal thrust of this supersonic body was appreciably different from the kinetic thrust or change of momentum of mass-flow through the machine.

Although the lightness of the ramjet was of primary importance in the struggle of power against weight, this advantage was very soon counteracted in transonic flight by a very high specific consumption. As an example, the effectiveness of the ramjet could be compared with that of the turbojet with re-heat in stratospheric flight for maximum range at $M=1.5$. Both jets were operated at the same and obviously excessive gas temperature of 1,500 deg C. at the entrance to the exhaust nozzle.

Denoting by a dash all the symbols relating to the ramjet, the formula for effectiveness in maximum range flight showed that, at a given speed V, the turbojet would better the ramjet in "propulsive weight" as soon as the ratio A/V was greater than $(p-p')/(\gamma'-\gamma)$.

In the case considered, which was at the limit of transonic flight

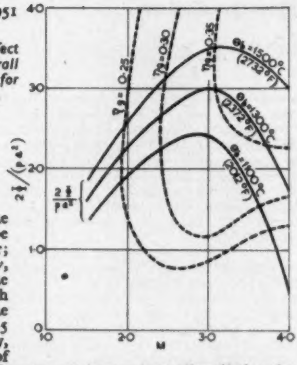

Fig. 5. Temperature effect on specific thrust and overall efficiency of a ramjet for various Mach numbers.

(V=1,000 m.p.h.), the following values could be assumed: $p/\gamma=0.4$ hr; $p'=0.4p$ and $\gamma'=2.5\gamma$, so that, under the same power, the turbojet with re-heat would surpass the ramjet after $0.4\times0.6/1.5=0.16$ hr, that is to say, after ten minutes of flight. Take-off and acceleration requirements as well as climb to the stratosphere were also to the disadvantage of the ramjet. Take-off, climb and flight through the transonic range depended fundamentally on the accelerating power at all intermediate speeds. Upon this was based, in fact, the judgment of experience with which theory had to agree, because it was experience that refereed the contest of power against weight.

LT. CDR. G. T. WEEMS, U.S.N.

THE death occurred at Delaware recently, following an accident to an experimental light seaplane, of Lt. Cdr. George T. Weems, a test pilot of the U.S. Navy. "Bee" Weems, who was 29, completed No. 8 course at the Empire Test Pilots' School, Farnborough, in December, 1949. Through his personal efforts, the course was enabled to visit the *Coral Sea* in the Mediterranean —and a visit to an American carrier is now part of the E.T.P.S. syllabus.

During the war, Lt. Cdr. Weems served in the Pacific, as an ensign aboard a destroyer and later as a carrier-based fighter pilot. His awards included the Silver Star, American D.F.C. and one gold star, Air Medal and four gold stars and a Presidential Citation. His post-war career included a tour as navigator of the carrier *Breton* and a period as a test pilot at Patuxent. Recently he became the first U.S.N. officer to qualify for paratroop wings, and he flew a number of missions on fighters from Japan and Korea. His father, to whom his friends in this country will extend sympathy, is Capt. P. V. H. Weems, an authority on navigation.

NOTHING NEW

UNDER the title *A Century of British Engineering*, a lecture was delivered to the Royal Society of Arts on Wednesday, February 28th, by Mr. W. T. O'Dea, B.Sc., M.I.E.E., Keeper of Aeronautical Collections and former Keeper of Engineering Collections at the Science Museum. His themes were that engineering, contrary to popular belief, has increased the extent to which skill is required of the worker; that it has removed much of the unpleasant labour from industrial processes; that the machine has created employment and has raised the standard of living; and that the failure to use machinery to the maximum advantage imperils those standards.

The lecturer said that mass production had become so associated in the modern mind with the present age that it was appropriate to explain that all three modern varieties, in primitive and very restricted form, were known a century ago. "If mass production means producing numbers of similar objects not necessarily to the highest degree of precision, it was achieved by Brunel and Bentham in 1804-8," he said. "They devised a series of machines that produced in a year 130,000 naval pulley-blocks when operated by ten unskilled men. The same output, formerly, would have required 110 skilled block-makers.

"If, however, by mass production is meant the assembly of large numbers of any product by use of a random selection from interchangeable component parts, the work of Whitney and North in the United States on musket production had been proceeding for half a century before Colonel Colt brought it to an almost modern-looking stage at the Colt Armoury, which was nearly finished, after four years' building, at the time of the 1851 Exhibition. The basic principle of production was the use of limit gauges to control the interchangeability of component parts.

"If, to defend the modern pride in mass production we are to fall back on what is now popularly known in engineering circles as 'flow production,' we must not forget that Bodmer, a Swiss who worked the later years of his life in Manchester, had laid out machines on a progressive operations system in the 1830s, and had devised a travelling crane to assist in the manipulation of the work. In 1815 in Switzerland, he installed what seems to have been a conveyor-belt system in a flour-mill."

Later in his review of progress during the 100-year period, Mr. O'Dea said that, for a century before the Wright brothers made the first controlled flights in a heavier-than-air machine, serious scientific work was being conducted on the problems of flight by such men as Henson and Stringfellow. "We have a great regard," he added, "for Maxim's huge machine of 1894, which would have flown had it not been held down by check rails."

Most early aircraft, said the lecturer, hardly looked like engineering jobs, with the possible exception of the Avro 504 of 1913. In 1917 the A. V. Roe works in Manchester were making ten Avro 504s a day.

THE ALL-SEEING CAMERA

AERIAL photography as an aid to archæologists was the subject of a paper read before the Royal Society of Arts on February 21st by Dr. J. K. S. St. Joseph, Curator in Aerial Photography at Cambridge University.

As readers of *Flight* who studied the article "The World in Camera" (April 13th 1950) will be aware, ancient foundations which have been overlaid by centuries of agriculture and are quite invisible on the ground can be seen and photographed from the air, especially with the aid of a low sun.

In his lecture, Dr. St. Joseph showed how not only the existence of such sites, but even their character and period, could also be clearly perceived in this way. Long-rooted cereals generally gave the most sensitive renderings of such hidden features; root crops were often just a blurred image, while grass, except in drought conditions, was seldom responsive. Thus, if a site were observed over a period of years and the land was under crop rotation, sooner or later the required information would be obtained by means of the aerial camera.

Some outstanding examples of the application of air photography to archæological knowledge, said the lecturer, were the Stonehenge Avenue, the prehistoric religious site at Dorchester, Celtic fields on Salisbury Plain, and Roman town-plans at St. Albans and many other places. Discoveries of new religious monuments had been made at Birrens (Dumfriesshire), Coupland (Northumberland) and Elston (Notts), and a large number of Iron Age hill forts had been discovered and photographed. In addition, our knowledge of the military and civil districts of Roman Britain had been enlarged. The aerial camera had revealed military sites on Watling Street, and public buildings, shops, houses and even mosaic or concrete floors in the old tribal capital of Wroxeter.

Owing to great building projects, open-cast mining, afforestation and agricultural development the surface of Britain was undergoing a swifter change than ever before. Visible archæological remains could be preserved, but hidden sites, which often contained greater historical material, were not taken into account. Air photography was the answer in compiling a planned national survey for record purposes. Time was short, and the opportunity in many cases, would not occur again.

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MAKING AIR TRANSPORT PAY

Mr. Masefield's Brancker Memorial Lecture. Part IV: How B.E.A. Controls Expenditure

IN our three previous issues we have published slightly abbreviated versions of the major portion of Mr. Peter Masefield's notable Brancker Memorial Lecture to the Institute of Transport. Below, in conclusion, are abstracts from the final sections of the paper, in which its author reviews B.E.A.'s system of expenditure-control and then briefly summarizes the theme of the whole lecture. Mr Masefield is, of course, chief executive of B.E.A.

I have now [said the lecturer] examined a method whereby factual airline, aircraft and route costs, together with revenue, can be forecast, planned and then compared and controlled against actual results. That is an important part of successful airline operation to which there is no adequate short cut. An equally important side to the business, however, is the detailed departmental control of expenditure.

In B.E.A. we have been operating a detailed system of budgetary control for two years. Briefly, it sets up a firm line of financial responsibility right through the organization and apportions that responsibility for expenditure under those properly concerned with its administrative control. Month by month the results gained are compared with those budgeted for the month. Any deviations from budget are immediately brought to light and can be dealt with.

In my view, the use of outside specialist consultants—standing aside from the domestic administrative problems of any concern—is of real value in assessing the need for detailed organizational development. We have had valuable help from Production Engineering, Ltd.

B.E.A. have evolved a system by which each administrative departmental head and, under him, each branch head, is responsible for a specified proportion of the budget. Decentralization and delegation is in this way possible without loss of effective cohesion and, as the administrative line is clear-cut there can be no dodging of responsibility. Thus, while the chairman and board are responsible for B.E.A.'s total expenditure from a broad policy point of view, the chief executive (who also shares policy responsibility) is directly responsible for the whole of the operating expenditure, amounting to some 99 per cent of the total. In our own case this total is exclusive of B.E.A.'s share of any losses incurred by associate companies and of the expenses of advisory councils.

By delegating our expenditure progressively down the line from department heads to foremen and even chargehands we have inculcated a cost consciousness throughout the organization. Each month actual results are thrown up against the budget. Instances of overspending can then be investigated and remedied. This monthly comparison is an essential part of the success of such a system.

A budget which remains rigid over the period of a year is not satisfactory in aviation—a developing business, affected financially by so many factors, many of them (e.g., fuel tax) outside the influence of the airline.

Hence we have established a system whereby the chief executive and chief accountant together accept or reject budget amendments submitted periodically by departmental heads. Amendments are admitted only if caused either by deliberate changes of policy affecting costs or by changes of major circumstances outside the organization's control. In this way a budget is maintained which is at once firm in its control but flexible enough to remain realistic. Furthermore, the annual budget is reviewed at half-yearly intervals. This system applies not only to expenditure, but also to revenue, and thus controls the whole field of commercial activity of the operator.

Allying this to the "moving annual totals" method of trend-analysis, to the aircraft type costing and to the route costing, means that a detailed monthly check of the position is obtained and rapid action is possible to set right deficiencies. A relatively large organization is thus kept flexible, and ready and able to use initiative to improve results.

By allying a realistic basis of cost-analysis with precise but flexible forward budgeting, by insisting on a clear line of authority and of financial responsibility, combined with a system incorporating substantial decentralization, and by comparing forecast results with actuals, month by month, and then acting on the information thus thrown up, a step forward in airline economic control is possible. Much remains to be learned and applied; but the possibilities are great.

Such [concluded the lecturer] is a wide—but superficial—survey of British air transport. I do not pretend that the suggested approach to airline costing is perfect—the whole business is constantly developing and progressing. There is still much to learn—in aviation we are always learning; but I do think that it offers possibilities of closer control than in the past.

My belief is that air-transport operations can be made into profitable, as well as essential, contributions to the nation's well-being. Certain "social" services will never pay. But in general, as the graph of B.E.A.'s cost and revenue rates shows, the economic future is full of promise. Without wishing to enter into political controversy in any way, I believe most sincerely that a period of stability is needed if the promise inherent in new and advanced types of British commercial aircraft is to be brought into its full usefulness and if scientific methods of analysis and control are to be developed and applied to achieve economic results.

One word of warning is necessary, I think. We are living in an era of rising prices. Air transport is one of the very few industries in which the revenue rates are today lower than they were three years ago and compare closely with revenue rates before the war. Although specific costs have been coming down steadily, the rise in wages and in costs of commodities, in a period of re-armament, may well halt this rate of fall and lead either to increased air fares or to increased deficits. Should this happen, it will be a sad disappointment for those who have worked to reduce the cost of flying and to bring air travel, economically and profitably, within the reach of every man and woman. If there should be such a pause, I am sure that it will be but temporary. Aviation is still in its pioneering days; much greater advances lie ahead than any which have been made in the past.

In the past there has been, as I have noted, a lamentable trend to hush up and conceal results. Not only has this tended to cloak inefficiency but it has meant that those who share the heat and burden of the day in working out air transport's salvation have not been able to feel that they are an essential, and fully informed, part of the team engaged in the job.

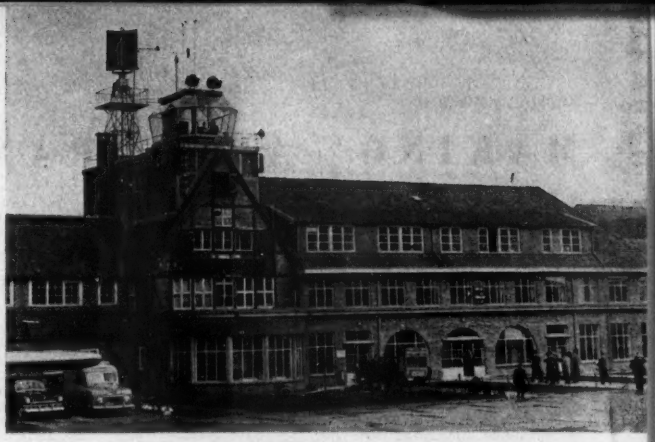
Only by full information and a wide understanding of what is being attempted and achieved can this, our air transport business, be built into a secure and economic edifice. Although a scientific approach is needed we must never forget that the working of the machine has to be done by human beings, each with his or her own personal approach. Full information of purpose and prospects and full consultation on ways to achieve the desired results are essential in any team—large or small.

In this presentation of facts and formulae I have kept nothing under the counter. Some may think that a revelation of full costs on the London-Paris route gives away economic information which should be withheld. I do not agree. Only by a full exposition and discussion of results and ideas can the progress be made in aviation which is so necessary to its wider use and of which no one concern can have a monopoly.

FORTHCOMING EVENTS

Mar.	15.	R.Ae.S.: "Towards Hydraulic Serviceability," by H. G. Conway, M.A., M.I.Mech.E., F.R.Ae.S., and R. H. Bound, F.R.Ae.S.
Mar.	17.	Helicopter Association: "Convertible Aircraft," by Capt. R. N. Liptrot, C.B.E., B.A.
Mar.	17.	British Gliding Association: Annual General Meeting.
Mar.	17.	R.A.F. College, Cranwell: Rugby and Fencing v. École de l'Air (home) and Hockey v. Royal Naval College, Greenwich (away).
Mar.	17.	British Interplanetary Society: Film Show, Central Technical College, Birmingham.
Mar.	24.	British Interplanetary Society: Film Show, Science Museum, London.
Mar.	29.	R.Ae.S.: "Modern Naval Aircraft Design," by D. L. Hollis Williams, B.Sc., F.R.Ae.S.
Mar.	31.	Army v. R.A.F. Rugby, Twickenham.
Mar.	31.	R.A.F. College, Cranwell: Hockey v. R.M.A. Sandhurst (away).
Apr.	6-10.	Physical Society: Exhibition, Imperial College, South Kensington, London, S.W.7.
Apr.	7.	British Interplanetary Society: "Evolution of Life in the Universe," by Prof. J. D. Bernal, F.R.S.
Apr.	12.	R.Ae.S.: "Comet Planning and Production Methods," by H. Povey, A.F.R.Ae.S.
Apr.	13.	College of Aeronautics, Cranfield: Senior Common Room Society's Annual Dinner.
May	6.	R.Ae.S.: Garden Party, White Waltham.

CIVIL AVIATION



THE OUTWARD EYE: The recent installation of G.C.A. at Melsbroek airport (Brussels) completes the programme of improvements planned by the Belgian Civil Aviation Department to make Brussels an all-weather airport. As shown in this photograph, an airport-surveillance radar scanner has been mounted on top of the control tower in the main administration building.

THE DESIGN OF ROTOR STATIONS

AT a meeting of the Helicopter Association of Great Britain, held on February 23rd, members heard some informative opinions on rotor stations (heliports) offered from the differing viewpoints of the public user, the town-planning authority, the architect and the scheduled operator. We give here a summary of the major considerations dealt with in the four papers read.

THE OPERATOR'S VIEWPOINT (Mr. R. H. Whitby, B.E.A., Special Developments).—Introducing his subject, Mr. Whitby said that if one authoritative statement could be made about rotor stations it was that no authoritative statement could be made on the subject.

In the matter of operators' requirements, he thought that, so far as the situation of rotor stations was concerned, they should be placed as near as possible to city business-centres, but should be sited with regard to the dangers which might be caused by nearby obstructions, which would affect regularity because of the need to observe higher weather minima. Ground rents would also be higher than was the case in suburban areas.

The dimensions of the site would depend on an assessment of the emergency requirements for large multi-engined helicopters, but the areas would probably need to be about 400ft in diameter. On the subject of aids he considered that V.H.F. communications would be likely to continue in use, although antennæ might have to be mounted on high buildings. He thought, also, that navigation aids which would involve no provision at the rotor station would be necessary. The attainment of high regularity would require some form of radio let-down which, for a "submerged" site, would involve problems similar to those associated with the communications equipment. Of visual aids he mentioned identification beacons and—to avoid overshoots in poor visibility—the desirability of a line of approach-path beacons.

A control tower in the form of a roof-top penthouse would be suitable to give traffic controllers a bird's-eye view of the hoverway and parking areas. Precise information on the safe descent-path (possibly from a light-pattern) would be needed by the pilot, as would some indication of his distance above the ground and surface wind direction at night.

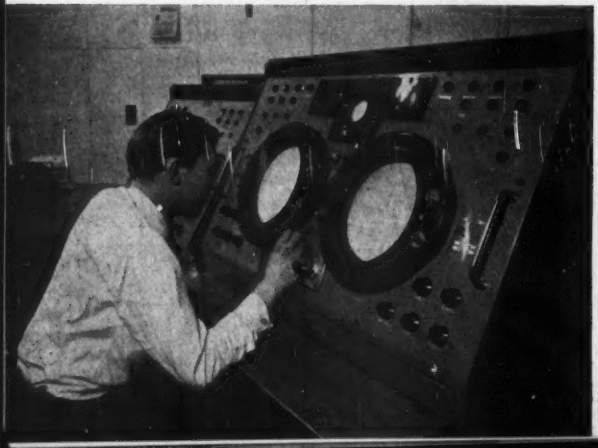
With regard to parking space required, the 400ft-square rotor station would provide room for at least four large helicopters with comfortable clearance. Tractors would be used for manœuvring machines on the ground, and at most stations refuelling points would need to be mobile. In addition, Mr. Whitby reviewed at some length the passenger-handling requirements which, he said, should be designed to assure far greater expedition than in the case of normal airline passengers.

THE PUBLIC USER'S VIEWPOINT.—A. Cdre. W. H. Primrose (director, Rotor Stations, Ltd.), disagreed with Mr. Whitby on several points, particularly those pertaining to the handling of passengers. Far from perpetuating the "bad old normal air-travel system" with all its complicated paperwork, he thought that the boarding of a helicopter should be as simple as entering a train or bus. He also considered that, in towns with a population of 50,000 or more, a first requirement was a multiplicity of rotor stations rather than one or two large termini. The stations themselves, would, of necessity, have to be of the elevated roof-top variety; surface sites would do only for small town and rural districts.

THE ARCHITECT'S VIEWPOINT. — Mr. R. S. Colquhoun, A.M.I.C.E., A.M.T.P.I., said that ground-level sites had much to commend them from the engineering point of view; landing areas could be turfed, but where there were more than 10-15 movements per hour a paved surface would be required. The speaker thought that rotor stations at the lowest capital cost were likely to be—in order—(*a*) the ground-level type situated on the fringe of a built-up area; (*b*) flexible-pontoon stations (on the lines of the "Whale" floating runways); (*c*) bridge platforms; and (*d*) roof-top stations. Individual situations might well change this order, however, and only a full design and cost analysis could provide the correct solution in any one case.

THE TOWN-PLANNER'S VIEWPOINT.—Mr. F. H. Littler A.R.I.B.A., A.M.P.T.I., said that siting appeared to depend on the four problems of accident danger, noise nuisance, traffic congestion and economic implications of land use. These would have to be examined in the light of possible advances that might be expected in multi-engined helicopter design. Although an examination of these problems seemed to show that while in existing towns rotor-station sites should be outside the true central business areas, in the planning of new towns there was opportunity to ensure that the effects of these problems were reduced to a minimum.

THE INWARD EYE: This interior view of the radar control room at Melsbroek (located beneath the main control tower) reveals the particularly neat layout of the radar presentation.



B.E.A. IN 1950

DETAILED figures are now available of B.E.A's financial results for the calendar year 1950. These show that the Corporation earned some £8,629,497, an increase of 28 per cent as compared with the figures for the previous year. The operating deficit was reduced by 37 per cent.

Signs of progress towards a profitable future are seen in improvements in operating cost and efficiency. Cost per capacity ton-mile was reduced by 11 per cent during the year, and the break-even load-factor was brought down from 76.2 to 65.1 per cent. Productivity (in terms of capacity ton-miles per employee) rose by 28 per cent.

Although these figures undoubtedly give cause for satisfaction, the Corporation's chief executive, Mr. Peter Masefield, has sounded a note of warning on the all-round rise in costs which, he says, will present B.E.A. with a big problem in the year ahead. Although it is the Corporation's policy to reduce fares whenever it is economically possible to do so, Mr. Masefield has intimated that, to meet rising costs, it may be necessary to make slight increases on one or two uneconomical routes.

B.E.A's first production Pionair is now due for delivery, Elizabethans should be introduced early in June, and the first of the Clansmen class, on which a number of essential modifications have still to be embodied, is expected to be in service early next year. At present detailed assessments are being made to determine

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CIVIL AVIATION . . .

the routes to which the latter type will be best suited, although it seems likely that it will be used mainly in Scotland, because of the restricted landing area at the Channel Islands airfield of Alderney.

On the subject of Scottish routes, incidentally, the Corporation is at present faced with a considerable problem for, in spite of the fact that recent operations on the direct London-Edinburgh route have shown that there is not sufficient traffic to justify a twice-daily service, the Edinburgh municipal authorities are insisting on the resumption of such a frequency. Scottish businessmen are apparently indignant that they should have to travel by road to Glasgow in order to catch an aircraft for London. The reduction in services is due to a shortage of aircraft and to the fact that the Corporation's Dakotas are now progressively undergoing conversion into Pionairs.

Going some way towards meeting the Scottish demands, B.E.A. have, from February 26th, re-introduced a daily service. The Lord Provost of Edinburgh was due to visit London last week to discuss the question further with the Corporation's chief executive.

Replying to a question in the House of Commons on February 28th, the Parliamentary Secretary to the Ministry of Civil Aviation, Mr. Frank Beswick, said that B.E.A. intended to re-introduce full services as soon as possible.

NAIROBI AND THE COMET

THE South African Air Transport Council, which met in Nairobi recently, has expressed doubt about the suitability of Eastleigh airport at Nairobi for operations by the D.H. *Comet*. It was, in fact, suggested that when the type is introduced on B.O.A.C's London-Johannesburg route next spring, it may have to use Entebbe instead. This suggests further consideration of the proposal, under discussion for some time, to build a more suitable airport—possibly at Embakasi—a few miles east of Nairobi. To this end an official survey of proposed sites has already been authorized.

B.O.A.C's vice-chairman, Mr. Whitney Straight (who, as mentioned in a recent issue of *Flight*, has visited Nairobi and discussed the problems involved), is known to favour a revival of the plan to build a new first-class airport nearby. This would certainly prove cheaper than the prohibitive cost of improving Eastleigh, where the location of the airport itself—placed, as it is, near a prominent hill and practically surrounded by an expanding suburb of the city—renders it undesirable for extensive use by large aircraft in conditions necessitating instrument landings.

Another consideration—constituting one of the main problems which would be involved—would be that of moving the numerous R.A.F. buildings, whose erection has cost about £4,000,000. One possible solution that has been kept in mind is that the R.A.F. buildings should be retained and a direct-access road constructed from Embakasi to the present site.

Although the plan to construct a completely new airport was rejected by the Kenya Government several years ago, it now seems certain that the matter will have to be given further consideration if Nairobi is to remain a link in the London-Johannesburg route.

ACCOUNTING EXPERIMENT

UNDER the supervision of the I.A.T.A. Clearing House in London—whose manager, Mr. A. J. Quin-Harkin, suggested the idea—four European airlines have agreed to test a new method of accounting for traffic transactions between the companies themselves. The principle involves calculation in terms of the distances flown rather than the actual cash value of the tickets. The experiment is intended to eliminate thousands of man-hours now spent in reducing the inter-line transactions to currency-exchange equivalents before sending them to the I.A.T.A. Clearing House. Instead, the companies will now account for sales of space on one another's services in terms of kilometres, arrive at consolidated monthly balances by offsetting credits and debits, and multiply the remainders by an average price-coefficient in order to make a final cash settlement.

The experiment has already begun with November clearances between B.E.A. and Swissair, while K.L.M. and D.D.L. will introduce their own transactions as the test progresses. For the purposes of the trial the clearance of inter-line transactions will continue by the present methods, but all transactions involving flights within Europe are being given a parallel clearance in terms of distance.

The object of the test is to determine whether clearance in terms of kilometres will produce a result close enough to that reached by orthodox measures. If it does, I.A.T.A. believes that the companies can effect extensive savings in accounting charges and will eventually be able to extend the principle of distance clearances to other parts of their route networks.

FREIGHT IN AUSTRALIA

ALTHOUGH only ten "all-freight" aircraft were operating in Australia last year (seven DC-3s and three Bristol Freighters), the total of freight carried on domestic routes exceeded 51,000 tons. A.N.A. handled 29,154 tons and T.A.A. 13,746 tons, while even Ansett Airways, a comparatively small company with a limited field of operations, handled 3,500 tons. The total represents an increase of 1,000 per cent on the figures for 1945. In 1949 the total for all companies was 31,719 tons.

This continued up-surge in the carriage of freight suggests that Australian operators will shortly be in the market for freighter aircraft of large capacity. Certainly, freight revenue is likely to represent an increasing proportion of the various airlines' total revenue sources. A.N.A. has already admitted that freight accounts for as much as 30 per cent of its total income.

THE CONVAIRLINER 340

COINCIDENT with the announcement that United Airlines have ordered 30 of the new Convairliner 340s, the Consolidated Vultee Aircraft Corporation has disclosed details of the performance and general arrangement of this type, which is an improved and enlarged version of the 240-A.

Although the 340 is based on the design of the well-tried 240, it is in fact almost a new aircraft, having greater wing area, a longer fuselage, increased all-up weight, more powerful engines, higher fuel capacity and many interior-design improvements. Wing area is 920 sq ft, as compared with 817 in the 240's wing; the increase is achieved by a span addition of 13ft 11in. The extra area, together with the new flap system, is intended to give better take-off characteristics at small airports.

At comparative weights the new model reduces the required take-off runway length by 1,000ft. The higher aspect-ratio has made possible an increase in gross weight, amounting to 3,200 lb over the 41,790 lb figure of the 240. To give additional range, integral fuel tanks contain an extra 150 gall, although at comparative range figures a 340 will carry 2,000 lb more payload at higher cruising speeds than would the previous version. Lengthening the fuselage by 4½ft has had the effect of allowing space for an extra four passenger seats and also gives a greater c.g. range to permit more latitude in loading conditions. Because of higher permissible cruising settings, the two 2,400 h.p. Pratt and Witney CB Series engines allow the 340 to cruise approximately 8 m.p.h. faster than the 240; they also give better take-off at high altitudes.

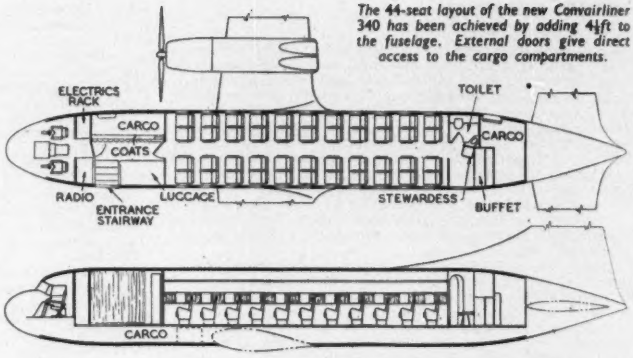
Pressurizing and air-conditioning systems will incorporate a number of improvements, including a hydraulic clutch which automatically compensates for reduced engine speeds and so permits air-conditioning

BRAZILIAN PRINCE: The first of the six Percival Princes ordered by the Brazilian airline, Aeronorte, is expected to be ready for delivery this month. The aircraft, which will be used on feeder services, have a 12-seat layout. The first machine, still wearing British registration lettering for test-flight purposes, is seen to be nearing completion in the assembly shops at Luton.

CIVIL AVIATION NEWS...

while the aircraft is on the ground Other detailed improvements include better distribution of the cabin-ventilating air and a redesign of the distribution ducting, valves and temperature controls. A completely new electrical system has also been fitted. As the accompanying diagram shows, a central electrical compartment is provided abaft the co-pilot's seat, to facilitate servicing of the major electrical accessories. The landing gear, also, is completely new and will incorporate a Decelostat unit to extend tyre-life by preventing skidding (see *Flight*, February 8th).

With the object of giving the 340 maximum flexibility of performance to meet operators' needs for several years to come, the manufacturers have so designed the aircraft that few modifications would be needed to convert it to turboprop power.



The 44-seat layout of the new Convairliner 340 has been achieved by adding 4½ft to the fuselage. External doors give direct access to the cargo compartments.

THE CHARTER MARKET

THE frequent dock strikes in this country in recent weeks have been the cause of a minor airlift between Britain and Sweden, and brokers' reports indicate also that it is likely to continue throughout this month. Various cargoes are offering for heavy four-engined machines on the outward flights, while loads of reindeer meat are available for shipping back as ballast at rates comparable with those of surface transport. A total of nine Halifax flights and six York flights were arranged between England and Gothenburg in a recent week, carrying motor-car parts, machinery and glass insulators.

The recent threat of a rail strike also brought a number of enquiries for heavy aircraft to stand by for flying newspapers to the North of England, Ireland and Scotland—very probably at short notice.

U.S. buyers are, apparently, still keenly interested in acquiring American-built aircraft, and the purchase of a number of DC-3s, Lodestars and Constellations is already under negotiation.

BREVITIES

AUSTRALIAN airline pilots have recently been awarded pay increases ranging from 25 to 33⅓ per cent. Under the new scales, senior captains of Skymasters and Convairs will receive from £A1,586 to £A1,826 per annum. The lowest rates on the scale are those for probationary first officers, who now receive £A606 instead of £A460.

* * *

American Airlines are to purchase three further DC-6Bs in addition to the 14 already on order. The airline hopes that all 17 machines, costing some $19,000,000 will be delivered this year. The aircraft are to be 52-seaters and will have six-seat lounges. When delivery is completed, American's passenger fleet will comprise 49 DC-6s, 17 DC-6Bs and 79 Convairliners, the largest post-war passenger fleet in the world.

* * *

Judging from advance bookings already received, services from South Africa to Britain this summer are expected to break all traffic records. B.O.A.C.'s Johannesburg office reports reservations up to May, while Pan-American have booked passengers as far ahead as June. S.A.A. have also received heavy demands for seats throughout the early summer months, and a K.L.M. official has said that bookings for April and May have been in hand since last November.

* * *

Plans for transforming Orly, the international airport of Paris, into one of the world's finest airline terminals were mentioned in an article in *Flight* of August 3rd, 1950. Now comes news of the first major step towards realization of the scheme. Under the Marshall Plan, counterpart funds amounting to 500,000,000 fr (about £500,000) have been allocated to the airport authorities for installing the necessary radar equipment and constructing essential sections of tarmac. Work will be started shortly.

* * *

Aer Lingus have confirmed that the number of Viscounts which they have on order is four. When put into service they will be used on all of the company's routes between Dublin and England and Scotland. Incidentally, Aer Lingus, recently scheduled 14 extra DC-3s between Dublin and Edinburgh on one day to carry 300 Irish supporters to the international rugby football match at Murrayfield.

* * *

P.A.W.A. have come to an arrangement by which Eastern Airlines will operate, under charter between New York and Miami, aircraft of Pan-American's Atlantic Clipper fleet which are now routed between New York and Florida without passengers. Pan-American will thus be relieved of the cost of ferrying empty aircraft between the two points while Eastern will be able to absorb additional traffic during peak periods over this high-density route. The agreement is said to be unrelated to the present request by the two companies for approval of an inter-change agreement the Miami-New York route and certain routes in Latin America.

* * *

The Chief Justice of the Nova Scotia Supreme Court is reported to have reversed a jury's decision to grant a mink-breeding company $10,000 damages as a result of the loss of a number of animals when a T.C.A. aircraft passed over the farm. It was found that the farm was established after the airline had begun operating on the route and the Chief Justice considered that, in any case, it was not the airline's duty to ascertain the location of mink ranches or fly so high that engine-noise would not disturb the animals. This test case is regarded as being very important in Canada where there are, of course, numerous such farms; airline managements in several other countries, too, have been watching the proceedings with interest.

* * *

In October, 1950, the British national airways corporations carried some 99,000 passengers—31 per cent more than in the corresponding month of the previous year. Two-thirds of this total flew on international services and the remainder on internal routes. Compared with October, 1949, passenger-mileage rose by 39 per cent to 77,000,000, with corresponding increases in freight and mail ton-mileage of 41 and 25 per cent respectively. B.O.A.C.'s figure for passenger-mileage was 41.9 per cent higher than that for 1949, while B.E.A.'s total was 31.9 per cent. higher.

* * *

British and Continental businessmen seeking markets for their products or new industrial sites in Canada are being offered the facilities of a new "industrial advisory service" set up by T.C.A.

Under the plan, which is intended to help industrial and trade expansion in Canada, the company will arrange for representatives of British and Continental firms to receive the assistance of T.C.A.'s district managers in Canada in making local business contacts. Full information is obtainable from T.C.A. European offices.

* * *

The Air Registration Board has announced two further issues of British civil airworthiness requirements. They are Section C—*Engines and Propellors* (*Issue* 2), and Section D—*Aeroplanes* (*Issue* 2). The pamphlets are obtainable from the A.R.B. Publications Department at Greville House, 37, Gratton Road, Cheltenham, Glos, and are priced at 4s and 7s 6d respectively. The published requirements are confined to basic airworthiness

matters, including the minimum equipment which has to be carried in stated categories. Requirements do not, however, prescribe additional equipment and instruments which must be carried in aircraft for specified flights in particular conditions; these are set out in Air Navigation Regulations.

* * *

On February 14th Philippine Air Lines celebrated their fifth anniversary. Since 1946 P.A.L. have flown a total of 32,000,000 miles and carried 1,500,000 passengers with an unimpaired safety record. In addition, nearly 57,000,000 lb of cargo have been lifted. An enterprising tour which the company is now organizing is a 16-day *shikar* to the Chanda, Balghat and Mandla hunting districts of Central India. The tour, which has been arranged in conjunction with Jeena and Co., Ltd., one of Bombay's leading travel agents, costs £431 5s per person, including shooting, with a reduction of over £100 per seat for parties of three or more. The price includes the cost of all hotels, transport, bearers, beaters, game licences, porterage and guides for the expedition.

* * *

In Eastern Australia, airline crews are experiencing difficulty in receiving 33 mc/s radio-range signals because of the simultaneous reception of distant range-stations using the same frequency. In some places interference is so severe that a station is ineffective as a navigational aid until the aircraft is within 30 to 40 miles of it. The cause is attributed to a propagation phenomenon known as "sporadic E-layer effect", and apparently little can be done to counteract it. The Australian Department of Civil Aviation has warned crews of the need for establishing definitely that the signals being received are those of the desired station. Thirty V.A.R. ranges, which are unaffected by the layer and which use frequencies in the 112-118 mc/s band, will shortly be put into operation.

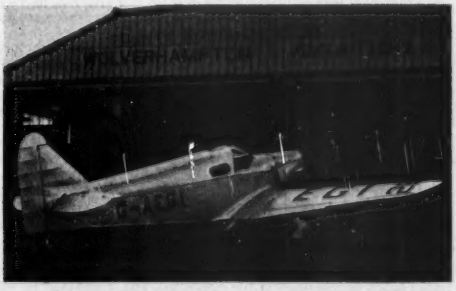
FROM THE CLUBS

THE Ultra Light Aircraft Association has now decided on the conditions which will govern the issue of its proficiency badges. A bronze wings badge may be given if members can produce evidence of having completed a minimum of five hours' solo on recognized ultra-lights; they must also undergo a practical test of flying skill and a technical examination. A blue enamel wings badge will be obtainable by members who have completed a minimum of 50 hours on ultra-lights and who hold a Private Pilot's Licence. A silver wings badge will be awarded to those who have completed 100 hours of flying exclusively on ultra-lights; of this total, however, 50 hours may have been flown on gliders of not more than 1,200 lb a.u.w. Aspirants to silver wings rank must also produce a certificate of "competency to perform aerobatics" in suitable ultra-light aircraft, and must prove their ability to carry out routine instructions and minor repairs in accordance with manufacturers' manuals.

The Association's highest award, a gold wings badge, will be given for flights which, in the opinion of the executive committee, are of outstanding merit. The first of these distinctions is being awarded to Mr. Peter Gooch for his flight in an Aeronca in July, 1949, during the Spanish Rally. The honour of holding the first silver badge is to go to G/C. E. L. Mole (until recently chairman of the Association), whose experience and flying time on numerous ultra-lights certainly qualifies him for this award.

AT the annual general meeting of the Northamptonshire Aero Club, held in the club-house at Sywell airfield on February 21st, the chairman, Councillor C. M. Newton, congratulated members on a successful year from both the flying and social viewpoints. It was disclosed that 22 new flying members had been enrolled and 25 Private and Student Pilots' Licences awarded. The annual totals of hours flown on instruction had risen by 78 dual and 40 solo, an increase which was considered to be very satisfactory, particularly as it was completely accident free.

The A.T.C. scholarship scheme is now reported to be running smoothly at Sywell and the club expects that, this year, more cadets will be allocated to it for training to P.P.L. standard.



OUT OF DOCK: The last Hendy Heck in this country, G-AEGI, has finally emerged from the protracted convalescence which followed its argument with a Spitfire after last year's King's Cup race at Wolverhampton. It suffered severe damage, and a suitable repair scheme was prepared only when its owner contacted Mr. Basil B. Henderson, who was responsible for the original design of the type. The Hendy Heck will be taking the air again shortly.

FOR FRENCH CONSUMPTION: As mentioned on this page, a number of these neat little two-seat Sipa 901 trainers are shortly to be delivered to French flying clubs. The aircraft made its first appearance in 1948.

A NUMBER of Sipa 901 two-seat trainers will shortly be delivered to flying clubs throughout France and the French Union. Nineteen machines have already been completed, ten of which are now undergoing delivery tests at Villacoublay. It is hoped that 40 aircraft will be ready by the end of March and that subsequently deliveries will be made at the rate of 15 per month.

A photograph of this versatile little machine, which is powered by a 75 h.p. Minié engine, appears on this page.

EVIDENCE of the valuable part which a personal aircraft can play in the work of a tea-planter comes from Mr. J. W. Collins, who recently returned to this country on holiday from Assam.

In 1947, the year in which he learnt to fly, Mr. Collins purchased on his own initiative an Auster Autocrat, which he flew out to Assam with an ex-R.A.F. pilot as navigator. The aircraft was placed at the disposal of the plantation owners, and its constant use in subsequent months soon persuaded the company to take over the machine.

An extensive earthquake which occurred soon afterwards gave the Auster an opportunity to more than justify its existence. In the floods which followed the earthquake, labourers sheltering in "leaf-houses" were fed and cared for by supply-drops of food and medical stores.

In the early days of Mr. Collins' 'plantation flying," landings were made on paddy fields, but landing strips were eventually constructed and there are now 16 throughout the tea gardens. Districts which were completely isolated are now visited regularly for the purpose of delivering telegrams, mail and supplies. Although expert maintenance has not been available for the Auster, which has been used almost every day for business purposes, the only defect reported to date has been the fraying of a brake-cable.

Flying over the tea areas has also enabled the planters to spot more easily the patches where the tea-plant is not growing satisfactorily and which, therefore, warrant a more detailed examination on foot. The checking of thefts of firewood, timber and thatch by natives outside the estates has been another part of the Auster's work. On one occasion the aircraft crossed a 6,000ft saddle-back mountain to visit the Apa Tani plateau, between Assam and Tibet, inhabited by a race which has had little contact with the outside world. In fact, so useful has Mr. Collins' Autocrat proved to his firm that it has since been decided to purchase an Autocrat and an Aiglet to improve communications throughout the tea gardens.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany these letters.

The late R. O. Shuttleworth in the famous Deperdussin monoplane, discussed by S/L. L. A. Jackson.

Historic Aircraft

MAY I be permitted to comment briefly on the letters from Mr. F. H. Coates and Mr. E. J. Arnsby appearing in your issue of January 18th last?

I agree that the Avro 504K was capable of performing a pleasant range of aerobatics, and I have no doubt that G/C. Snaith, a very experienced Avro pilot, who flew the 504 at last year's R.A.F. display, would have liked nothing better. However, for the reasons mentioned by Air Cdre. Wheeler in his article in *Flight* of February 8th, it was not possible to do this.

With regard to the Shuttleworth Deperdussin's engine, I am afraid that Mr. Arnsby is in error. The Y-type Anzani at present fitted is the same one that he saw at Heathrow in 1937 and, indeed, it is the original motor fitted to the machine when the previous owner bought it in 1913. I enclose a photograph showing the late Mr. R. O. Shuttleworth in the machine at Gatwick *circa* 1937. The absence of the auxiliary exhaust ports will be noted. Perhaps Mr. Arnsby is thinking of the fan-type Anzani fitted to the Shuttleworth Bleriot XI, which has the extra exhaust ports in the cylinder walls.

In the early days alterations and modifications appeared almost as quickly as they do to-day, and it is seldom possible to state categorically that this or that variant is absolutely representative of any particular type.

Old Warden, Beds. L. A. JACKSON.

The Horsa's Load

I FOUND your article "Ferry to Ambassador," in the February 23rd issue, most interesting and informative. There was, however, an error in your data concerning the Horsa glider, which, I feel sure, you will wish to correct.

The troop-carrying capacity was given as 15 fully armed men. In actual fact, the Mk 1 originally carried 32 "bods," and subsequently an extra seat was fitted, bringing the total to 33 plus the two pilots.

Possibly there was some confusion with the American Hadrian or Waco, the capacity of which was 15.

Birmingham 26. ERIC HILL (ex-G.P.R.).

[The manufacturers state that the military load of the Horsa, including the seating accommodation, was 6,900 lb. Since a standard paratrooper, fully equipped, weighed 237 lb, the number which could be carried may be determined as 29 though the official number, it seems, was 28, plus the two pilots.—ED.]

International Navaids

IN reply to my recent letter Mr. Powell (February 15th) has raised the question of Flight Logs and the accuracy of V.O.R. It would be quite simple to produce a map presentation with a V.O.R./D.M.E. system on a non-distorted map, but I think the concensus of opinion amongst pilots is that a course to steer and distance to go to a given position are preferable to a position-fix from which this information has to be worked out.

The Airborne Instrument Laboratory's published report on the V.O.R. divides the errors into a number of distinct components, which may be summarized as follows: (*a*) A ground-station error which can be compensated for by calibration; (*b*) a receiver error which is less than plus or minus 1 deg when properly adjusted; and (*c*) a non-systematic error which varies so rapidly that its effect on the aircraft course is much less than the instantaneous magnitude of the errors would imply. (See Airborne Instrument Laboratory Report, Vol. 1, page 115).

In any case, the four-course M.F. range system now in use caters for much higher traffic-density in America than will apply in Europe for many years to come. The V.O.R. will allow for still further density. The limiting factor here will surely be the traffic-handling capacity at airports rather than accuracy *en route*.

In giving details of the Decca track guide and the integrated track range Mr. Powell does not altogether answer the queries of my letter. The track guide on trunk routes only gives a bearing which can also be obtained either from M.F., A.D.F., or a homing display on the D.M.E. It is difficult to see how the integrated track-guide will be any cheaper than the four-station Decca chain, because of the difficulty of locking the "distance" slaves, which will have to be at least 250 miles from the track-guide pair. Such information as is available on radio interference levels and propagation conditions in the tropics leads me to the view that it is unlikely that locking could be carried out in the normal Decca fashion, and that land lines or beamed radio links would have to be employed. In either case the expenditure must inevitably be high.

Edinburgh. W. GREGSON.

Ranks On Recall

HOW true is your leader of February 8th about the R.A.F.V.R.! This week I received a letter asking me to volunteer for flying-instruction duties with the R.A.F. for a period of 18 months or more. I cannot consider the question as, although I had almost 3½ years' commissioned service with the R.A.F. before leaving as a flight lieutenant and an A.1 instructor, plus three years in the R.A.F.V.R., I am now offered only the rank of flying officer, i.e., asked to spoil my civilian career in order to occupy that rank.

For the last three years I have, in effect, done a 6½-day week—5½ as a chartered accountant and one as a flying officer in the V.R. And for what? To be asked to lose a considerable sum—several hundred pounds? I might add no gratuity appears to be offered for 18 months' service.

Wolstanton, Stoke-on-Trent. STILL FLYING TIGERS.

[Our correspondent is correct in his remark about gratuities—the grant of £125 per annum applies only for short-service engagements of three years and over. It is understood that the amount of a proposed bounty for 18-month engagements has not yet been decided.—ED.]

Keeping The Flag Flying

I READ in your editorial in the February 23rd issue of *Flight* that ". . . for the first time since the old Calcutta biplanes flew out along the Empire routes our maritime nation is without its universally admired fleet of merchant flying-boats. . . ."

Please allow me to contradict you. Our proud maritime nation *has* a fleet of civil flying-boats—albeit a small one and operated under private enterprise. But this company's servants, from board to junior employee, believe in them.

Aquila are now operating Hythes to Madeira, twice weekly from Southampton and once weekly from Lisbon. This month the services are being stepped up to three times weekly from Southampton and in April they will be twice weekly from Lisbon. At the beginning of April, therefore, there will be ten movements a week in Madeira, five in and five out. Is there not, therefore, a *small* merchant fleet of British flying-boats? It is true that in May the services from Southampton will be reduced, but other services are in the offing—e.g., to the Canary Islands.

Prospects for the flying-boat sank to an all-time low level last November, when B.O.A.C. withdrew their Solents and my company were operating only once every three weeks between Southampton and Madeira. I am certain, however, that they are now on the rebound and will soon regain their rightful place in British civil aviation.

London, W.1. BARRY T. AIKMAN,
Managing Director, Aquila Airways, Ltd.

Festival Railplane

MAY I answer Mr. J. R. Dixon's remarks under the heading of "Noisy Project" in *Flight* of February 23rd? My idea was essentially for a show piece; the passenger side of it was incidental. The Benny railplane was built some 20 years ahead of its time. The novelty of the machine even to-day might have given that added touch of ingenuity to the exhibition, and if powered by jet turbines it might have been good publicity. I quite realize the noise factor and the inefficiency of slow-speed operation; I merely say again that the idea of operating such a coach over some circuit or other would have been another "first" for Britain.

Shepperton, Middx. R. RUSSELL.

Do you know your airfields?

8

Recognize this airfield? It's No. 8 in this series of puzzle photographs. You'll find the answer below on the right.★

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This new Switch can be used in conjunction with a warning lamp or flag indicator to indicate a predetermined level of fluid in a tank. Other applications are that of a refuelling cut-off switch, under special conditions, or a pump cut-off switch for 'tank empty' conditions. Alternative terminal connections are provided for either 'make' or 'break' contacts with a positive snap action. It may be fitted on the top, side or bottom of the tank. The Fluid Level Switch is suitable for 5 amp. 24 Volts non-inductive load and data sheet C.503 which gives full technical details and dimensions, is available on request.

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SERVICE AVIATION

Royal Air Force and Naval Aviation News

"Flight" photograph

PACIFIC WAR-STATION: The flying-boat moorings at Hong Kong; on the buoys are seen four R.A.F. Sunderlands, a U.S.N. Mariner and an air-sea rescue launch. In the background are the runways of Kai Tak and the town of Kowloon

ON the successful conclusion of the delivery of 44 Vampires 5s to re-equip fighter squadrons of Far East Air Force, Marshal of the R.A.F. Sir John Slessor, the Chief of the Air Staff, has sent the following message to the A.O.C.-in-C., Transport Command, Air Marshal Sir Aubrey Ellwood :

"Please convey my congratulations to all who have played a part in the F.E.A.F. Vampire ferry operation. This operation (in all probability the longest of its kind undertaken with jet aircraft) has been completed according to schedule and without serious mishap. This reflects great credit on air and ground personnel alike.

"All concerned may rest in the knowledge that they have partaken in an experiment which has shown that modern fighter aircraft can be ferried over long distances through all types of weather conditions. In consequence of this the mobility and flexibility of our jet fighter force has been greatly increased."

The Vampires were flown—by pilots of Transport Command Ferry Flight—from Chivenor, Devon, to Changi, Singapore. The journey, of 8,850 miles, was made in 18 stages through 11 different countries. From Chivenor, the aircraft flew to Fayid, Canal Zone, *via* Dijon, Istres, El Aouina (Tunisia), Castel Benito and El Adem. At Fayid, they were assembled in convoys of six, and flew, with a Mosquito navigational escort for each convoy, to Changi, *via* Mafraq (Jordan), Habbaniya, Bahrein, Sharjah (Persian Gulf), Mauripur, Palam, Kampur, Barrackpore, Mingaladon (Burma), Don Muang (Siam) and Butterworth (Malaya).

The arrival at Changi of the first six Vampires, which made the journey from Britain in just over 27 hours' flying time, was described and illustrated in *Flight* of December 14th, 1950.

Commenting on a newspaper report that "British jets are expected to be in action over Korea very soon," the Air Ministry says that no plans have yet been made for the operational deployment of R.A.F. jet aircraft in Korea. However, the Royal Australian Air Force has ordered 36 Gloster Meteor 8s. Some are believed to have been delivered and may see action over Korea shortly with No. 77 Squadron, R.A.A.F.

For Training In Canada

THE second party of National Service cadet-pilots, 30 in number, for training in Canada were due to leave Lyneham by Transport Command last Tuesday. They were accompanied by the first five N.S. navigators to be posted to the R.C.A.F. for training. Twenty more navigators will fly to Canada by B.O.A.C. on March 11th. The first party of National Service pilots left England in January and are now training at Gimli, near Winnipeg. The navigators will be posted to Summer side, Prince Edward Island. Further parties of aircrew cadets—Regulars and National Servicemen—will leave for Canada at intervals through the year.

R.A.F. "Ideal Home"

AN Air Ministry stand at the *Daily Mail* Ideal Home Exhibition which opened at Olympia this week shows the type of kitchen—with built-in fittings and labour-saving devices, and with dining-room recess—provided in airmen's married quarters now being built for the R.A.F. Two other rooms show the type of kitchen and furniture provided in married quarters for the R.A.F. in 1931, and for the Royal Flying Corps in 1913, and a third gives an impression of what a kitchen in Service married quarters might have looked like a century ago.

Hastings for New Zealand

FOR re-equipment of the R.N.Z.A.F., the New Zealand Government has ordered from Handley Page, Ltd., a number of Hastings transports. First

CO-ORDINATION CHECK: With the increased demand for aircrew, the Combined Selection Centre at Hornchurch is receiving an increased flow of candidates. Typical test-apparatus, seen in use, consists of a control column with which candidates attempt to keep a spot of light in the centre of a screen. Flashing red lights, which have to be switched off by a "throttle," add to the difficulty.

PARIS PARTY: Among those present at the recent opening of the R.A.F. Association's new continental H.Q. in Paris were (left to right): Air Marshal Sir Richard Peck; Marshal of the R.A.F. Sir John Slessor; A. V.-M. George; Gen. Larminat; and M. Livry Level, formerly R.A.F. and now a Deputy of Paris.

SERVICE AVIATION . . .

deliveries are expected towards the end of this year. Hastings C. Mk 3s have been ordered. This version has the later Hercules 737 engines, which should confer better performance and reliability.

Both the Hastings 2 (as now being delivered to the R.A.F.) and Hastings 3 have an all-up weight of 80,000lb, compared with the 78,000lb of the Mk 1. Payload thereby benefits by an increase of 9 per cent, and ultimate range is extended to 4,000 miles.

Navy's Rugby Success

BY beating the Army fifteen 11-3 points at Twickenham last Saturday, the Royal Navy became the winners for 1951 of the Inter-Services Rugby Football Tournament. It was a well-deserved win by the livelier team. Previously the Navy had beaten the R.A.F., 6-5 points. It is the Navy's first success since the war. The R.A.F. meet the Army in the final match of the Tournament at Twickenham on March 31st.

ROTARY RESCUERS: The R.C.A.F. is using Sikorsky helicopters as part of its Search and Rescue organization. Members of a helicopter-crew pictured during a recent search are Cpl. Burrow, L.A/C. Greenough and S/L. McLeish.

Mobile Radio Exhibition

A MOBILE radio servicing exhibition, devised by the R.A.F. Central Servicing Development Unit, is now engaged on a three-month tour of radio and radar factories all over the country. Its purpose is to give to the industry a more complete picture of the total radio installation in modern military aircraft and to acquaint designers, by personal contact, with the problems involved in maintaining the complicated equipment in efficient working order, using National Service manpower. Examples of specific good and bad design from the servicing aspect are displayed in three mobile classrooms, exhibits being labelled in red to denote bad design, or in green to indicate good design. Makers' names are not shown.

A team of experienced N.C.O.s, under the command of a flight lieutenant, is travelling with the exhibition. It is considered that the spoken word is even more valuable than the exhibits themselves in putting over the problems and in suggesting improvements.

The radio industry welcomed the suggestion that the exhibition should visit factories. The London area has already been covered, and during the next few weeks the exhibition will visit factories in Salford, Manchester, Edinburgh, Rugby, Leicester, High Wycombe and Ilford. Altogether 28 factories are being visited.

In recent years the R.A.F. has devoted much attention to simplifying the servicing of aircraft. Static aircraft exhibitions have been arranged at which representatives of the aircraft industry could see examples of how thoughtless placing of equipment requiring frequent attention could create difficulties for the maintenance crews. The new mobile exhibition represents the first attempt to deal specifically with radio and radar equipment. It is also the first time that equipment has been taken to the industry at its own factories for demonstrations of this type.

Air Ministry Appointment

THE appointment is announced of A.V.-M. R. G. Hart, C.B., C.B.E., M.C., as Director-General of Technical Services (II) at the Air Ministry. He succeeds Air Marshal C. W. Weedon, whose appointment as Controller of Engineering and Equipment was announced recently. A.V.-M. Hart, who is 52, has commanded No. 90 Group since February, 1949, and was previously Director of Technical Policy at the Air Ministry.

R.N.V.R. Flying Time

DURING 1950, the four R.N.V.R. air squadrons flew a record total of over 7,000 hours. The greatest individual total —2,749 hours—was contributed by the largest squadron, No. 1832 at Culham, which made 176 deck-landings during its ten-day spell of carrier training in H.M.S. *Theseus*.

The only R.N.V.R. anti-submarine squadron, No. 1830, is equipped with Fireflies and is based at Donibristle, near Dunfermline. No. 1830 Squadron's 1,851 flying hours during 1950 included a flight by 16 of its aircraft to Malta, *via* Marseilles and Rome, for annual training. This consisted of anti-submarine exercises with the Mediterranean Fleet. The unit's non-aircrew members were flown to Malta in a chartered Dakota.

Flying times of the other two squadrons, Nos. 1831 (Stretton) and 1833 (Bramcote), were respectively 1,471 and 1,031 hours. Both took part in inter-Service exercises during the year and 1833 Squadron went to sea in H.M.S. *Illustrious*.

The R.N.V.R. squadrons, other than No. 1830, are equipped with Seafires. A second Firefly squadron, however, is now being formed at Culham and will eventually be based at Ford.

Reunions

R.A.F. Stations Hurn, Harwell, Rivenhall, 38 Group and Airborne Forces Old Comrades Association.—Annual reunion dinner at the Paviours' Arms, Westminster, London, on Saturday, April 7th,, at 1900hr. Details from W. Scrivens, 54, Lombard Street, London, E.C.3.

* * *

Headquarters Bomber Command Association of Officers.—Sixth annual reunion at H.Q., Bomber Command, High Wycombe, Bucks, on Saturday, May 19th, 1951. Details from the Hon. Secretary of the Association at the above address.

* * *

H.Q. 44 Group and O.A.C. Gloucester. —Third reunion dinner (stag) for officers on Friday, March 16th, 1951. Details from T. Morris, 17, Hyde Park Street, London, W.2.

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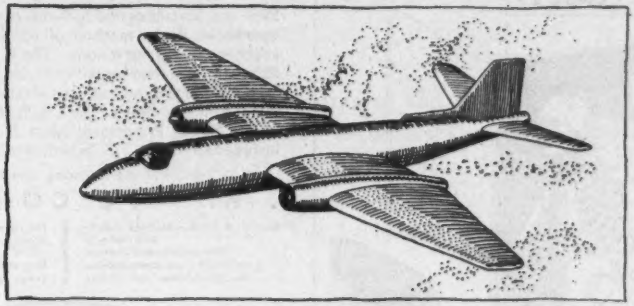

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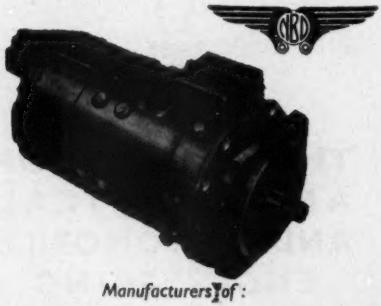

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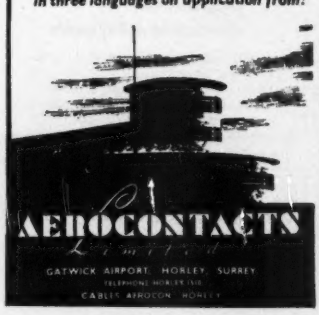

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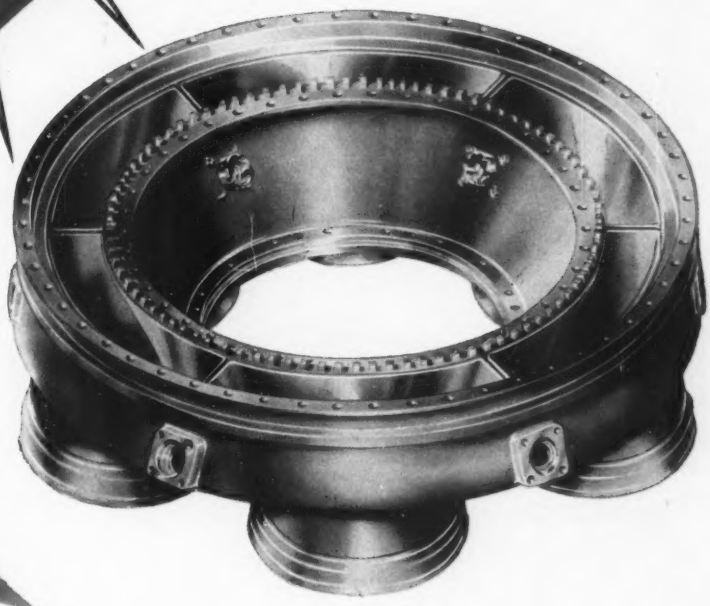

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